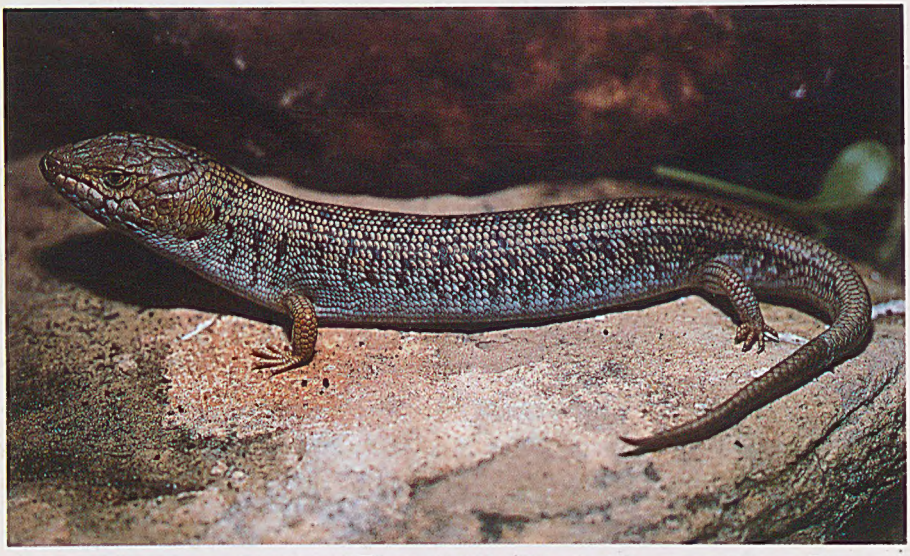
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HERPETOFAUNA

Volume 22 Number 2 December 1992



The Spotted Tree Frog *(Litoria spenceri)*: a large gravid female (length 52mm) found at Bogong Creek, Kosciusko National Park, New South Wales. (photo Harald Ehmann). This species is the subject of one of the articles in this issue.



The Adelaide Pygmy Bluetongue *(Tiliqua adelaidensis)*: an adult male caught near Burra, South Australia. (photo Graham Armstrong) An article on this species appears in this issue.

Herpetofauna incorporates the *South Australian Herpetologist* and the *Bulletin of Herpetology* and is published twice yearly by the Australasian Affiliation of Herpetological Societies. The Affiliation started on an informal basis in 1974 and was formally established in 1977. It is the result of a formal agreement between member societies to participate in cooperative activities.

The Affiliation's objectives are to promote the scientific study of amphibians and reptiles and their conservation, to publish the journal *Herpetofauna*, to encourage liason between member societies at the Regional level. It is not intended to be a separate society, nor is it to deplete member societies of their vital expertise and resources.
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SECOND WORLD CONGRESS OF HERPETOLOGY

December 29, 1993 to January 6 1994 in Adelaide, South Australia

This most important event for Australian Herpetology has been structured around several themes including Ecology, Evolution, Zoogeography, Physiology, Behaviour, Conservation and Captive Care and a special single-day theme Herpetoculture, Zoos and Private Herpetology.

Registration for the entire Congress (if completed before 1st October 1993) costs $395 (Australian currency). For a copy of the Congress Final Circular and further details contact The Sectretariat, Second World Congress of Herpetology, Department of Zoology, University of Adelaide GPO Box 498 Adelaide 5001 Australia. AUSFAX 08 2235817, International FAX 6182235817.

We have negotiated and developed with the Congress Directors the special single-day theme HERPETOCULTURE, ZOOS, and PRIVATE HERPETOLOGY to be held as part of the Congress on Wednesday 29 December at a venue very close to NARAMA (see page 2).

The theme co-ordinator is Harald Ehmann and this theme day is specifically designed for herpetologists who pursue their interest on an unpaid (amateur) basis, for personnel employed in zoos and animal parks, and for keepers and breeders.

The theme day HERPETOCULTURE, ZOOS, and PRIVATE HERPETOLOGY will include the following symposia each 90 minutes duration;

- Husbandry and Captive breeding. Convenor - Gerry Swan.
- Zoos and Wildlife Parks. Convenor - Chris Banks.
- Contributed papers on any topic relevant to the theme but preference will be given to those papers presenting personally funded herpetological studies, e.g. field surveys, species studied. Convenor to be announced.
- Demonstrations and Workshops: e.g., photography, field techniques, poster presentations, etc. Convenor - Harald Ehmann.
- A free guided tour of NARAMA.

Call for Presentations

We are now calling for presentations and contributions to this theme program. Please communicate your interest to the theme co-ordinator by 30 April, 1993. If you wish to present a paper and want to have the abstract published in the Congress Abstracts you need to submit two copies by July 1, 1993 (write for more details). Spoken presentations will be limited to 15 minutes (12 speak, 3 for questions). Slide and overhead projectors will be available.

Registration for the Theme Day

Registration for this single day theme costs $40 (Australian currency): this format and fee structure has been especially devised for those who are not able to attend the entire Congress but who want to attend a complimentary meeting of persons with similar interests.

The fee entitles you to attend "Herpetoculture, Zoos and Private Herpetology" and receive the associated lunch, refreshments, abstracts and circulars, and a guided tour of NARAMA.

Please send your name, address, and registration fee to the theme co-ordinator by October 1, 1993 at the latest.

For interstate and overseas registrants who require accommadation we are able to arrange some limited billeting with local society members. If you need this assistance you must write to the theme co-ordinator by 30 June, 1993.

Correspondence to:
The Theme Co-ordinator,
Herpetoculture, Zoos and Private Herpetology, PO BOX 9 Blackwood, South Australia 5051
AUSFAX 08 2703280 International FAX 6182703280

NARAMA
FIRST AUSTRALIAN EXPO OF REPTILES AND AMPHIBIANS
1993 - 1994

Complementing the Second World Congress of Herpetology to be held in Adelaide, 29th December 1993 to 6th January 1994, will be the most extensive exhibition of reptiles and amphibians ever held in Australia.

The theme is an intergrated one, incorporating herpetology with Aboriginal culture, and showing the importance of native plants in both. NARAMA - an Aboriginal word for "Rainbow Serpent" - is based on the display of up to 150 species of reptiles and frogs, and numbers of other animals relevant to the ecological theme.

The experience and enthusiasm for the exhibition is based on the early, very successful Native Wildlife Shows in Adelaide and more recent, equally well received, Adelaide Snake Catchers' displays which have evolved into the business 'WILDLIFE EDUCATORS'.

Some of the highlights for NARAMA are:

- Displays of endangered species, including the Pygmy Adelaide Bluetongue.
- Innovative methods of publicly displaying wildlife such as habitat-based, authentically landscaped, multi-species display modules.
- Special emphasis on interpreting NARAMA to overseas Congress delegates as a practical introduction to Australian ecosystems.
- Exciting integration of live displays, plants, video imagery, mood music, demonstrations, guest speakers, species interpretation and much more.
- Display features include most of Australia's dangerous snakes as a focal point, separate exhibits for sea-turtles, crocodiles and sea snakes, walk-in python exhibits, specific frog/tad-pole displays,potted native plants indicating major habitats of Australia, and Aboriginal culture integrated throughout the exhibition.
- Central stage area for venom extraction, demo's, visiting guests speaking on various topics, especially frog/tadpole conservation and endangered species.

Extensive nation-wide marketing for NARAMA will start in September at the Royal Adelaide Show and continue thereafter up to and during the expo. Overseas and interstate delegates to the World Congress will receive information as soon as we have sponsorship commitments. Schools, youth groups and relevant government agencies will also be kept informed about NARAMA during 1993.

Australian herpetologists are invited to contribute to or become involved in NARAMA. There are many varied ways you can have input. For those living in or near Adelaide you may like to assist with the presentation of short public displays/demonstrations/talks, and we will need help with the day-to-day staffing of NARAMA. More distant contributors are needed to send (preferably by post) materials needed for landscaping the displays (e.g., bark, leaf litter, small logs of fallen wood and soil). We are also keen to hear from anyone wishing to promote their display equipment who could at the same time provide anything from vivaria, to aquaria, to filter pumps, to air conditioning units. Anyone interested in sponsorship at any level should make contact as soon as possible. You may like to help in other ways.

Please telephone, fax or write to WILDLIFE EDUCATORS for more information and a complete list of areas of involvement.

Geoff Coombe,
Robin Noye,
Rudy Della-Flora

Principals
WILDLIFE EDUCATORS
PO BOX256, O'Halloran Hill, SA 5158
Telephone (08) 387 2692 or
Telephone/Fax (08) 364 3684

THE REDISCOVERY OF THE ADELAIDE PYGMY BLUETONGUE *TILIQUA ADELAIDENSIS*; (PETERS, 1863)

Graham Armstrong,
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Salisbury East SA 5109

Julian Reid,
CSIRO Division of Wildlife and Ecology,
PO Box 2111,
Alice Springs, NT 0871

INTRODUCTION

This article reports the circumstances and events surrounding the rediscovery of the Adelaide Pygmy Bluetongue *Tiliqua adelaidensis*, a scincid lizard which has previously been thought to be extinct (Cogger 1992, Hutchinson 1992).

In October of 1992 we were participating in The South Olary Plains Fauna Survey. The survey was a joint project of the SA Department of Environment and Land Management and the South Australian Museum. At midday on Wednesday 14th October an unscheduled trip into the northern Mt Lofty Ranges township of Burra to refuel set in motion a series of events which culminated in the capture of the first live *Tiliqua adelaidensis* since October of 1959.

THE FIRST SPECIMEN

At 12.30 pm on Wednesday 14th October 1992, while travelling to the township of Burra from survey sites on the plains immediately to the east of the northern Mt Lofty Ranges we stopped to examine the corpse of an Eastern Brown Snake *Pseudonaja textilis*. The snake had only very recently been run over and was relatively undamaged. It was laid belly up on the bonnet of the vehicle and palpated by GA to detect the presence of any recent meal. A hard walnut sized lump was felt in the stomach and a decision was made to open up the snake and identify the prey item.

The surrounding countryside consisted of treeless hills characteristic of the northern section of the Mt Lofty Ranges where crop and sheep production have been the mainstay of the region's rural community for well over a century. Taking the surrounding landscape into consideration an assumption was made that the bulge would prove to be only a small house mouse *(Mus domesticus)*. The dissection was performed by GA with little sense of apprehension. Bending the limp body of the snake over the fingers of the left hand an incision was made in the snake's belly approximately five centimetres anterior to the palpated lump. The ventral scales and attached tissue immediately parted revealing the characteristic dorsal pattern of a *Tiliqua adelaidensis* which was instantly recognised from published photographs of preserved specimens and cursory glances of specimens in the SA Museum collection. Bewilderment and disbelief turned into astonishment and then elation as nervous fingers manipulated the snake's body freeing the lizard's head from the confines of the abdominal cavity. There was no mistaking the lizard's identity.

The specimen was an adult male with a snout-vent measurement of 97mm and was free of any gross signs of digestion. The coppery brown coloured dorsum was flecked with black scales which were most concentrated in the vertebral region where they appeared as a linear series of flecks from the nape to the base of the tail. The source of the palpated lump had been the lizard's distinctive head which, when compared to other skinks of a similar size, appeared disproportionately large for its small tapering body.

Of immediate concern was the appropriate preservation of the specimen. After taking careful note of the odometer reading for future reference, the journey into Burra was completed whereupon Dr Mark Hutchinson, Curator of Reptiles at the South Australian Museum, was contacted. The advice of MH was to freeze the specimen intact in the hope that its tissues would be suitable for DNA extraction and analysis. This meant that the specimen had to be immediately taken back to our base camp at Redcliffe Station.

The following day GA returned to the vicinity of the road kill accompanied by Jan Birrell of the SA Museum. The site was amongst gently undulating hills which were intersected by drainage gullies. It was next to one such gully that the snake had attempted to cross the road. The gully contained a seasonal creek which in places was flanked with rock outcrops, composed predominantly of shale. These rocky protrusions provided ample habitat in which to search for reptiles but after 3 hours of rock turning and crevice searching no bluetongues had been found. However, numerous other reptiles were recorded from the area among which were two adult male Tawny Rock Dragons *Ctenophorus decresii* which had been killed by raptors. Their mangled bodies were left lying beside the rocks on which they had presumably been perched prior to their demise.

On the afternoon of the 16th October several other survey members joined us in the search but inclement weather limited the duration of the visit. Another species of reptile was uncovered, however, bringing the number of species recorded in the area to twelve.

At this stage, having made the exciting discovery of the ingested bluetongue but failing to find living animals despite the active search efforts, it appeared that the Pygmy Bluetongue would prove to be quite cryptic in behaviour and to minimise disturbance to the habitat we concluded that the use of pitfall traps was probably the best way to search for the species.

FURTHER SPECIMENS

Four days later on 20th October, Mark Hutchinson assisted by experienced field herpetologists David Armstrong and Brian Miller again unsuccessfully searched the initial area. On gaining the support and assistance of the local landowners they also searched a similar site some eight kilometres away where MH chanced across another lizard apparently preyed upon by a raptor. Ecstatically, MH informed his colleagues that the lizard was another *Tiliqua adelaidensis.* Inspired by these finds Brian Miller returned to the area the following week. After almost two days of unsuccessful endeavour he returned to the site of the first find and in the upper region of the gully came across yet another dead *Tiliqua adelaidensis.* This third specimen was lying beside a rock and had been decapitated and partly eviscerated.

Inevitably a sense of intrigue and frustration began to descend on all who had become involved in the search. Graham Armstrong and Jan Birrell returned to the area on the weekend of 31st October and Ist November and laid out twenty five Shermann traps along the creeklines near each of the two localities. Again the fickle spring weather struck. Temperatures struggled to reach twenty degrees centigrade. Not surprisingly the only catches were a house mouse in each of the two lines.

By this time MH had arranged funding for a more prolonged and intensive survey of the area and had enlisted the help of Tim Milne, a zoology graduate who had been a volunteer on the South Olary Plains Survey. TM's job was to remain in the Burra area for 6 weeks to maintain a series of pitfall lines. On 3rd November MH's original team plus TM began establishing the pitfall lines. One line was close to the site where BM had located the third specimen and while the series of pits were being dug an Eastern Brown Snake *Pseudonaja textilis* was observed and promptly ushered away. When the snake reappeared some minutes later it was captured. That evening MH processed the snake and performed a dissection whereupon the partially digested remains of a fourth *Tiliqua adelaidensis* were discovered.

THE FIRST LIVE ADELAIDE BLUETONGUE

These four separate finds, three from one small area, suggested that a sizeable population of *T.adelaidensis* was likely to be present in the vicinity of the pitfall lines. So it was with some confidence that the team returned to Adelaide leaving TM to maintain the trap lines. They were not disappointed. On the afternoon of November the 6th while TM was doing his rounds he peered into a pit along the line where the Eastern Brown Snake had recently been caught. As he did so, from the bottom of the pit, a small scincid lizard cocked its head side on and stared up. The first live *Tiliqua adelaidensis* in thirty three years had been captured!

DISCUSSION

Active searching of the general vicinity of the finds prior to the establishment of the pitfall lines revealed the presence of fifteen species of reptile besides the four dead *T.adelaidensis* (Table 1). Most of these species were found frequently with the exception of two Geckonids - *Nephrurus milii* and *Diplodactylus vittatus* - and one snake - *Suta spectabilis*. The fact that no live *T.adelaidensis* were located during this initial opportunistic search phase was probably due in part to the species' very cryptic habit and also to the lack of information regarding its habitat usage. The only references to the previous mode of collection relate to just three specimens; one collected under stone and two collected simultaneously from a hole under a concrete slab (Ehmann 1982).

Of the species which were uncovered *Tiliqua rugosa, Tiliqua scincoides* and *Pseudonaja textilis* are commonly encountered in rural environments within their respective distributions. The occurrence of *Ctenophorus decresii, Nephrurus milii* and an undescribed species of *Gehyra* (the 2N = 44 *"variegata"* chromosome race of King, 1979), however, can be linked directly to the availability of suitable rock refuges. In addition notable grassland species are also present such as *Delma molleri* and *Menetia greyii*. Which of these recognisable habitat components, or other as yet unspecified features has enabled *T.adelaidensis* to persist in the area is currently one aspect of MH's study.

The locality of this population of *T.adelaidensis* lies within the species' presumed historical distribution which, although not well documented, is the general vicinity of the foothills of the Mt Lofty Ranges and adjacent plains from Adelaide to Burra (Ehmann 1982, Hutchinson 1992). This is a region of Australia in which ecosystems have been dramatically altered since European settlement. Nevertheless two specimens of *T.adelaidensis* were collected near Burra in the early 1940s although the exact date and location of the collection could not be ascertained (Ehmann 1982). The vegetation of the area encompassing the site of the rediscovery was classified as *Lomandra multiflora - Lomandra dura* association (Jessup 1948). In addition to the presence of *Lomandra* species Jessup referred to the area as possessing "the characteristics of grassland." He noted "the general absence of trees" and stated that the treelessness of the area, although difficult to explain, "is definitely supported by early survey reports". It is interesting therefore to note that the gullies and adjacent slopes which constitute the search area still contain remnants of this association. Although exotic species predominate, a significant proportion of the grass and herbaceous flora which carpets the area consists of residual native species (JR pers. obs.). Small isolated patches of *Lomandra* also remain.

We may take heart, therefore, from the fact that the existence of rock lined gullies and adjacent hillsides, with their remnants of native grassland floristic communities, has provided an important refuge for a relatively diverse suite of reptile species which fortuitously includes the rare Adelaide Pygmy Bluetongue.

The rediscovery is encouraging as it will inevitably lead to a broadening of the search for this species from areas of remnant native vegetation into more modified landscapes. This will be essential in order to delimit the species' current distribution and ensure its long term survival. Undoubtedly this will be a protracted process but if the determination and enthusiasm previously

exhibited by contemporary professional and amateur herpetologists in the pursuit of this species is any guide, then the future of *Tiliqua adelaidensis* appears promising.

Table 1.

a) List of reptile species recorded from the immediate vicinity of the rediscovery.

Aprasia pseudopulchella
Delma molleri
Diplodactylus vittatus
Gehyra sp. (2n=44 - "variegata")
Nephrurus milii
Ctenophorus decresii
Pogona vitticeps
Lerista bougainvillii
Menetia greyii
Morethia adelaidensis
Tiliqua adelaidensis
Tiliqua rugosa
Tiliqua scincoides
Pseudonaja textilis

b) Additional species found in the general vicinity.

Hemiergis decresiensis
Suta spectabilis

ACKNOWLEDGEMENTS

We thank Dr Mark Hutchinson for making available details of his preliminary field work at the site of the rediscovery and for his comments on the original manuscript.

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HOW AUSTRALIAN WILDLIFE PROTECTION POLICIES IMPEDE HERPETOLOGY

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ABSTRACT

Australian wildlife conservation efforts are largely focused on the legislative protection of individual vertebrate specimens and particular high-profile species. A network of state and federal legislation controls all activities that involve the maintenance, display or study of reptiles (and in some cases frogs) - living or preserved. Other activities, such as photography, that might 'interfere with the natural progress' of native species are also controlled. This paper represents a condensation of a presentation made at the 1991 International Herpetological Symposium held in Seattle, Washington. It is an attempt to evaluate, from an amateur herpetologist's perspective, the effects of Australia's highly restrictive conservation legislation on amateur and professional herpetology, the public exhibition of reptiles and the conservation of Australian herpetofauna.

A survey of amateur and professional herpetologists was undertaken and the results are presented. The survey underscored divided views as to the value of the legislative restrictions on amateur study. Although the amateurs themselves were almost unanimously critical of the legislative constraints imposed upon their activities, about half of the professionals surveyed supported these constraints and overwhelmingly expressed the view that their own herpetological activities are not significantly impeded by the legislation. Zoo keepers viewed the constraints placed on amateurs unfavourably and indicated that their own activities are also substantially impeded by the legislation.

BACKGROUND

In less than 20 years all Australian states and territories have gone from having virtually no protection for their herpetofauna to adopting blanket protection of all reptiles (and frogs in some states and territories). Tasmania was the last state (1991) to draw up protective legislation for its reptiles. The legislation in all states and territories generally allows the collection of most reptile species for bona-fide scientific projects undertaken by professional herpetologists, but have more or less banned the collection of specimens by amateur herpetologists. (Defined as any private individual who collects, keeps, or otherwise studies reptiles and/or amphibians without being paid to do so, and who is not a postgraduate student of herpetology). In New South Wales, hobbyists are allowed to collect and maintain a total of two reptile specimens, to be chosen from a list of 14 'exempted' species, but the hobbyists in that state have been generally critical of the makeup of that list and the restriction to keeping only two specimens. In that state, all frogs have recently come under the protection of the National Parks and Wildlife Act, and the traditional family activity of collecting tadpoles of common frog species to observe development and metamorphosis is now punishable by fines of thousands of dollars and/or imprisonment.

The trend to protect fauna on valid conservation grounds has been international, but in most other western countries, the collecting of common reptile species for hobbyist purposes is generally tolerated, possibly because the keeping of reptiles in those countries was a fairly entrenched activity when legislative changes were contemplated. In Australia, where the hobby was neither well established nor organised when the legislative push of the early 1970s began, the establishment of a prohibition against the collecting of reptiles was implemented virtually unopposed. Amateur aviculture, on the other hand, was very well established and organised and is presently much more widely tolerated by the legislation, as is the maintenance of native fish.

In more recent years there has been an increasing adoption of both 'animal welfare' and 'animal rights' ideals by Australian legislators, and the collection of specimens from the wild for hobbyist purposes or zoological exhibition is now viewed in most states and territories as 'exploitative' and prohibited on these, as well as the original 'conservation' basis.

To varying extents, most of the states and territories allow the keeping of certain reptiles by hobbyists where these are legally acquired from other captive sources. However, permits and licences for such transactions are generally only reluctantly issued, and in some cases, only when it can be shown that the action or transaction fulfils some 'bona-fide' scientific study as endorsed by a professional herpetologist. In order to restrict the distribution of specimens amongst hobbyists in some states it is illegal for the few licensed hobbyists to breed their captive reptiles. Several states and territories ban the importation of legally acquired specimens across state boundaries though this may well contravene provisions of free trade outlined in the Australian Constitution. Many authorities appear to go to great lengths to police the restrictions placed upon amateur herpetologists. Hobbyists who maintain illegal collections of herpetofauna risk heavy-handed raids of their homes, complete with search warrants and confiscation orders - not unlike the operations of 'drug busts'.

Zoos are affected by the stringent legislation in that they are rarely able to obtain specimens from the wild and as a result only a very small number of native species are currently displayed in Australia. Zoos are also finding it more and more difficult to obtain non-indigenous species from overseas due to their 'pest potential' as perceived by government authorities, should the imported animals escape and colonise. At first the difficulties were experienced primarily by privately-funded institutions, but the effects of tighter legislative controls are creeping into government-owned zoos. The recently formed Australasian Herp Taxon Advisory Group (Herp TAG) includes both privately and publicly funded zoological parks and aquaria. Herp TAG has expressed the view that the federal legislation presently imposes unreasonable restrictions on the ability of zoos to move animals, including those species which are not under threat. The Wildlife Protection Act of 1982 impairs the interaction of Australian zoos with overseas zoos, because few exportations from Australia are allowed, and due to the amount (and detail) of information required before a transaction can be undertaken. The movement of reptiles into and out of Australia is only very rarely permitted, and privately-funded facilities may not export live native specimens under any circumstances.

Those professional herpetological researchers who have criticised the Australian statutory approach to wildlife conservation (Tyler 1979; Rawlinson 1981; Ehmann and Cogger 1985) have claimed that while providing government bodies with a politically convenient and relatively inexpensive means of 'doing something' for the environment, this process has tended to divert public attention (and consequently government funding) from more important activities such as the identification and preservation of disappearing habitats, control of feral pests, fundamental research programs and public education. Criticisms of the prohibition approach against the taking of specimens for amateur study or hobbyist purposes were summarised by Ehmann & Cogger (1985): "We cannot conceive of any non-commercial harvesting activity which would cause concern for any more than a small minority of Australia's 850-plus species of frogs and reptiles". Peter Mirtschin (1991) assessed the value of the 'blanket ban' approach to conservation somewhat more rigorously with his assessment that "the second greatest threat to herpetofauna conservation in Australia is the very legislation supposedly established to address the greatest threat to herpetofauna conservation - habitat degradation".

It would seem fairly universally accepted (Tyler 1979; Rawlinson 1981; Buridge and Jenkins 1984; Ehmann and Cogger 1985) that the significant threats to Australian herpetofauna are:
1. physical degradation of habitats brought on directly or indirectly through the activities of man,
2. feral pests, and
3. commercial exploitation; the only Australian examples of this threat to date have been the uncontrolled crocodile skin trade between 1940-70,& the current legal harvesting of sea snakes.

Quite apart from man-induced causal agents, it is often overlooked that many wild populations of both reptilian and non-reptilian vertebrates are subject to massive fluctuations in response to variable environmental factors, especially rainfall patterns. To a much lesser extent, road mortalities and the Australian tradition of killing snakes may contribute to localised declines in particular species, but there is no biological evidence nor serious scientific opinion indicating that herpetological activities (professional or amateur) in Australia have led or could lead to declines in reptile or amphibian populations (except for a few highly threatened taxa). Neither is there evidence that the restrictions which have been imposed have led to an increase in herpetofauna populations. However, the ever-tightening wildlife regulations have certainly had the unfortunate effect of discouraging amateur herpetological activities, thereby alienating many of those who would otherwise have become strong supporters of genuine conservation measures. The legislative emphasis on protecting specimens rather than ecosystems has resulted in a negative effect on reptile conservation, not only because it has steered interest away from the subject, but because it has given the appearance of conservation action where none really exists (Ehmann and Cogger 1985).

For nearly 20 years, herpetofauna protection in Australia has used the law enforcement approach as a conservation priority despite condemnation from various quarters around the world. The First World Congress of Herpetology held in Kent in Canterbury, UK (Sept 1989) established the "Committee on the Preservation of Reptiles and Amphibians through Captive Husbandry and Propagation" (CPRACHP) to promote the recognition of amateur herpetology worldwide. The draft objectives produced at the Congress were as follows:

1. To establish that the live animal trade, as used by pet keepers, zoo keepers, and professional herpetologists, is a negligible factor in population depletion;

2. To admit that most herpetologists got their interest and much of their training with 'pet' reptiles and amphibians;

3. To acknowledge that the subsequent contributions to herpetology by amateurs has been considerable. It includes entry into the profession by some, serious husbandry and breeding efforts by others, and serious conservation efforts by others.

4. To demonstrate that the current conservation laws are contrary to the needs of species preservation, in that they

 a) are written for ease of enforcement, which severely limits access to specimens by qualified students;

 b) provide protection to animals but not their habitats, which effectively renders them useless;

 c) makes serious amateurs and many professionals criminals in the eyes of the law, or near enough to criminal to elicit ill-will from many colleagues.

5. To move herpetological societies with large or predominantly professional memberships to acknowledge as a matter of policy that:

 a) contributions made by amateurs are of importance;

 b) such serious amateur efforts should be encouraged by cooperation from professionals, and;

 c) laws restricting access to animals need serious revision that will allow greater access to live specimens by all interested persons.

There have been a few influential Australian herpetologists who have publicly recognised that the international problem outlined by the World Congress is present in Australia, but by and large there has been very little public expression of support for the amateurs. One of the more

influential herpetologists to publicly acknowledge the problem in recent years was Allen Greer (1989): "Amateurs have contributed substantially to the development of Australian herpetology, as will be evident from the references to their work in this book. Their importance derives primarily from their observation of live animals: captive specimens, a species seen during a field trip, or a local fauna. They publish without the inhibitions of having to preserve a professional image, and if they fail to understand the full ramifications of what they have seen, at least they have put into the literature an observation that can be taken up and developed by someone else. Unfortunately the role of amateurs in Australian herpetology is now under threat from certain state authorities. Rules and regulations make it increasingly difficult to collect, keep, or even disturb in order to observe or photograph native fauna. For many amateurs who are often either too young to fight or have no affiliation with another, protective bureaucracy like a museum or university, this means giving up or going "underground". As a result, much opportunity for knowledge and personal development through investigation, discovery and discussion is lost".

In order to test the views of amateurs and professionals alike as to the impact of the proliferation of Australian wildlife protection legislation upon the herpetological activities of hobbyists, zoological exhibitors and professional herpetologists, a survey was undertaken. A questionnaire was devised with the assistance of the Australian Herpetological Society - a predominantly amateur group of approximately 200 members, with a view to collect the considered views of the herpetological community.

Copies of the questionnaire were distributed through the newsletters of several amateur herpetological associations. Others were mailed to members of the Australian Society of Herpetologists - an association comprised primarily of professional herpetologists. Copies were also mailed to all Australian museums employing herpetologists, and to most Australian zoological facilities holding substantial reptile or amphibian collections. All recipients of the questionnaire were invited to make copies of the form and distribute them to other herpetologists.

Participants in the survey were asked to provide their name and describe their level of involvement/interest in herpetology (professional herpetological researcher; university graduate student; employed as reptile keeper at a zoo, reptile park, etc; or amateur herpetologist and/or hobbyist reptile keeper). They were then provided with a list of six questions - though participants identifying themselves as professional researchers, graduate students or zoo keepers were asked to skip question number 1 and those identifying themselves as amateur herpetologists and/or hobbyist reptile keepers were asked to answer all questions except questions number 2 and 3. Following are the questions asked in the survey.

1. Do you presently maintain reptiles in a hobbyist capacity? (yes or no). If not, why not?
(a. disinterested in doing so; b. the difficulty/impossibility of obtaining approval from relevant statutory authority to hold or obtain the species of reptiles which would be of interest; c. other - please explain).

2. Did you maintain reptiles at any time before pursuing your career in herpetology or zoo keeping?

3. Would you say that the collecting and/or keeping of reptiles by yourself or someone you knew acted as a catalyst leading to your present interest and involvement in herpetology or zoo keeping?

4. Insofar as it controls the activities of amateur herpetologists, do you think that fauna protection legislation and its associated regulations and policies in your state or territory is: (a. not restrictive enough to adequately conserve native reptile populations; b. fairly balanced and justified - playing a positive role in the conservation of native reptile populations; c. too restrictive

- having a limited role to play in the conservation of native reptile populations and therefore unfairly curtailing the activities of amateur herpetologists; or d.other - please explain).

5. Do you feel that existing state and/or federal fauna protection laws are discouraging the cultivation of the professional herpetologists of tomorrow?

6. Which of the following best describes the overall effect that state and/or federal fauna protection laws/regulations/policies have upon your herpetological activities? (a. they substantially restrict or impede your herpetological activities; b. they are at worst somewhat annoying, but do not restrict your herpetological activities to any significant degree; c. they make your herpetological activities easier to achieve; d. other - please explain).

DISCUSSION

Of the 85 survey participants, 35 described themselves as professional researchers (17 being employed by Universities or the CSIRO, 9 being employed by museums, 6 being employed by wildlife protection agencies, and 3 who did not specify where they worked). Of the remaining participants in the survey, 7 described themselves as university graduate students, 13 as zoo keepers, and 30 as amateur herpetologists and/or hobbyist reptile keepers.

The findings of the survey demonstrate that although the professional herpetologists and graduate students were largely (81%) of the view that their own activities were not impeded to any significant extent by the legislation, they were fairly evenly divided on the issue of present restrictions on the activities of amateurs (45% approving, or indicating a need for tighter constraints; 40% not approving of current constraints). The 6 participating professional herpetologists employed by wildlife protection agencies were highly supportive of the present restrictions upon amateurs (5 in support of status quo vs 1 not in support), and with the deletion of these data a slightly more sympathetic view is expressed by the professional herpetologists, with 34% supporting the need for current (or tighter - one participant) restrictions upon the activities of amateurs, 48% not approving of the current restraints, and 18% registering their tick marks in the 'other' category.

The majority of amateurs (80%) indicated that their activities were substantially restricted by the legislation. The zoo keepers also indicated the opinion that their activities, as well as those of the amateurs were adversely restricted by the legislation.

The majority of the professional herpetologists (71%) indicated that they maintained reptiles at a hobbyist level before pursuing their careers and (66%) claimed that hobbyist reptile keeping led to a herpetological career decision. Interestingly, however, only 43% of the professional herpetologists expressed the view that the legal constraints presently imposed upon amateur activities are discouraging the cultivation of the professional herpetologists of tomorrow, although if the 6 professionals employed by wildlife protection authorities (who unanimously indicated 'no' to this question) are removed from the data, 52% of the remaining professionals answered 'yes', 41% indicated 'no', and 7% abstained.

Although the promise of confidentiality prevents a close analysis, it is interesting to note that there was a strong tendency in the survey for the more widely known and published herpetologists to express the view that present legislative controls relating to amateur activities are too strict and without conservation justification, and that they are discouraging the cultivation of the professional herpetologists of tomorrow.

Most of the results of the survey were fairly predictable, though the views of approximately half of the professional herpetologists and graduate students, that the legislation as it pertains to the amateur herpetologists is 'fairly balanced and justified - playing a positive role in the conservation of native reptile populations' may come as a surprise to many amateurs and professionals alike. A number of different factors may contribute to the unsympathetic view held

by many professionals concerning the problems that amateurs claim to be confronted with, these factors possibly including:

1. To date there has been very little dialogue between the amateur and professional herpetological communities. Perhaps some professionals are unaware of the stringency of the legislative restrictions presently imposed upon amateurs.

2. Possibly the fact that the most professional herpetologists in Australia are entirely funded by the state or federal government has led to a tendency not to be critical of 'the hand that feeds'.

3. An underlying distrust of amateurs may exist due to the perception that illegal activities relating to the collecting and keeping of reptiles are prevalent among amateurs.

4. Perhaps after nearly 20 years of suppressed activities faced by amateur herpetology, some of the younger professionals have little interest in amateur herpetology simply because they were legally circumvented from that stage of career development. This would not necessarily be a healthy thing for Australian herpetology, considering that most of the truly prolific contributors to Australian herpetology (and indeed, 71% of those sampled in the present study) have had careers which could be dated back to an early hobbyist-level interest in herpetofauna - activities that are now largely illegal. Due to the prohibition against the collecting of reptiles in most states and territories, responsible parents have learned to discourage their children from early interest in the subject.

5. Perhaps some professionals simply do not recognise the existence of a link between public education and conservation in the same sense as Rick Shine (1991), who argued that "for every pet diamond python in a Canberra living room there will be literally hundreds of friends, schoolmates, relatives and general acquaintances whose attitudes to snakes will be changed for the better". Alternatively, perhaps there is a view that any benefits derived by the removal of specimens for hobbyist purposes, while educationally valuable, do not sufficiently compensate for the potential of over-collecting from the wild.

6. Possibly, some professionals hold concerns that unsatisfactory conditions of husbandry may adversely effect the welfare of captive reptiles.

7. Perhaps the reason that many professionals surveyed failed to support the amateur cause is simply that they are to focused on their own short-term aims to see the big picture. This would be to ignore the current legislative trend, which is to forbid the taking of specimens. Although their work may not be outwardly hindered by the growing conservation/animal rights blend of wildlife management philosophy as yet, the future could see increased onus placed onto scientists to prove, possibly to an ethics committee comprised of laymen, tangible and possibly short-term ecological justification for their activities when these require the taking of specimens. This is not inconceivable - the government-owned zoos were very non-committal when constraints relating to animal welfare began to creep into the governmental control of privately funded zoos, but it now appears that they too are becoming affected by the restrictions in ways that they see are unjustifiable from a conservation viewpoint.

CONCLUSION

Fauna protection laws and regulations are undoubtedly necessary, but as implemented at present are often irrational and needlessly restrictive. The laws and policies of the various states and territories direct surprisingly little attention towards the preservation of habitats, population monitoring, research activities or public education. They presently impede the activities of amateurs and provide professional herpetological researchers with a lot of paperwork, but appear to do nothing much to ensure reptile conservation. The Australian public would no doubt expect that herpetologists who draw their salaries from public funds are obliged to play an active role in influencing the formation of the conservation priorities and directives of statutory authorities where these relate to native herpetofauna. However, to date there has been little

visible effort from researchers to steer wildlife bodies away from their current preoccupation with law-enforcement-oriented goals and onto proper conservation missions. One very important exception is the recently launched National Action Plan for reptile conservation being undertaken by Dr H.G. Cogger of the Australian Museum on behalf of the Australian National Parks and Wildlife Service. Dr Cogger has widely invited public submissions relating to the nomination of reptile species requiring conservation action. This project will be Australia's first ever conservation action plan relating to endangered reptiles and amphibians.

Without support, the amateur herpetologists appear to be ineffective in their negotiations with relevant statutory authorities. The cause of the amateurs is a justifiable one and worthy of the support of herpetological profession for the following reasons:

1. If the conservation of reptiles and amphibians is desired, then our knowledge of them must be improved. Public appreciation should be fostered for these little known and in some cases, much maligned animals. Increased public awareness and appreciation of the ecological role of reptiles and amphibians is fostered by simple contact with them.

2. Ironically, from an animal welfare point of view, governmental regulations designed to protect the welfare of reptiles and amphibians have forced many hobbyists to pursue their interests 'underground' and have discouraged rather than encouraged responsible private keeping.

3. One of the more unfortunate consequences arising from the limitation of amateur activities is that the traditional pathway leading from hobbyist reptile keeper to keen amateur researcher to a professional career in herpetology is lost. The earliest herpetological activities of many world renowned researchers such as Harold Cogger and Richard Shine would, if conducted today, be regarded as illegal. The responsible action of parents today is to not allow their children to pursue their natural interests in herpetology.

4. Australia is a large country with a large, relatively poorly understood herpetofauna. Amateurs have in the past been able to contribute to a better knowledge of reptile and amphibian distributions, reproductive patterns, dietary requirements, etc. Through their publications in reptile club newsletters and popular science journals they have until recently been able to contribute substantial worthwhile scientific information. Unfortunately, these publications (including Herpetofauna), have indicated an increasing shortage of articles submitted from amateurs while at the same time, in other western countries, there has been an explosion of publications by amateurs.

5. Because the activities of professional herpetologists in Australia are almost entirely funded by the government, their activities have always been financially constrained. The amateur herpetologists require no government funding, dedicating their own resources - both financial and time to their study.

6. Whether or not reptiles and amphibians have statutory protection has no bearing on their true conservation status. By focusing on a law enforcement style of conservation program, the very limited funds available for conservation of herpetofauna are largely squandered on the costs of upholding the policy.

It may be that the professional herpetological community is the appropriate group, and the Australian Society of Herpetologists the appropriate forum, to approach relevant government bodies with a view to discussing the cause of the amateur herpetologist - not only because it is a fair and just one, but because the future of professional herpetology may be more directly linked with that of the amateurs than is widely recognised.

In view of the perception of statutory wildlife protection authorities that insufficient conservation/education benefits arise from the activities of amateur herpetologists to justify the taking of reptiles from the wild, professional researchers would do well to wonder how much longer they will be able to rely on the potency of the 'professional scientific investigation = conservation'

argument to justify their activities where these require the collection and captive maintenance of specimens.

It would be a logical first step to addressing the problems perceived by the amateur herpetologists and by a substantial proportion of the professionals surveyed if communication between the two groups could be undertaken. Once such a dialogue is established, it may prove that in at least some cases, the research projects undertaken by professional herpetologists and statutory wildlife protection bodies (i.e. the National Action Plan) could benefit by the involvement (and subsequent nurturing of skills) of amateurs into particular worthwhile directions. This, for some hobbyists, might eventually lead to a contributing role in the maintenance and breeding of captive populations of threatened species.

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RITUAL COMBAT IN THE HIGHLAND COPPERHEAD *AUSTRELAPS RAMSAYI* (SERPENTES, ELAPIDAE).

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A highland form of the common copperhead *Austrelaps superbus* has been recognised for many years (Rawlinson 1969, 1971) and in recent years has been called *Austrelaps ramsayi* in a number of publications (Sutherland 1983, Shine 1987, 1991, Coventry and Robertson 1991). Other authors did not recognise it as a species (Cogger 1986, Jenkins and Bartell 1980, Swan 1990) and the taxonomy of the copperhead group was only formally settled in a posthumous paper by Rawlinson (1991) who elevated the highland form to full specific status as *A.ramsayi.*

The highland copperhead is commonly found in the montane regions of eastern Victoria and New South Wales and is the only copperhead species to occur in the Canberra region. This paper presents the first account and photograph of what is presumed to be ritual male combat in this species.

Although the snakes were not sexed, it is assumed because of the extent of entwinement and the continual positioning of the head of one individual on the back of the other, that these observations were of ritual combat between two males. The fact that both snakes were large and similar in length also suggests that both were males. This species is highly dimorphic with females considerably smaller in body size (Shine 1987). Ritual combat has been previously recorded in the highland copperhead (Shine 1987) but no details were given.

The observations were made at approximately 11.00 am at an elevation of 1020 metres, 22 February 1989 in Namadgi National Park in the south of the Australian Capital Territory (148° 50'E, 35° 38'S).

Whilst driving along a four-wheel drive track beside the Cotter River, two snakes were observed tightly entwined around each other in the middle of the road (Figure 1). I could not stop the vehicle before reaching the snakes and so straddled them with the wheels and passed over them before bringing the car to a halt. The commotion of the vehicle had caused the snakes to part and they were lying motionless in a loose coil, one on top of the other.

Both snakes were estimated to be 90-100 cm long. This is substantially larger than stated by Worrell (cited in Sutherland 1983) who considered a large specimen of this species to be about 60 cm total length. As I approached closer to photograph them the snakes moved off along the track with one snake appearing to try to remain on top of the other. The snakes moved about 10 metres along the track always with the one snake moving on top of the other. The snakes then entwined the middle part of their bodies and lay quite still.

Muscular contractions could be seen in the body of at least one snake and it was assumed that these were constricting contractions. Due to other field commitments, observations had to cease and I left the snakes tightly entwined. The duration of the observations from first sighting to my departure lasted approximately 15 to 20 minutes.

Ritual combat has also been previously reported in the common copperhead *Austrelaps superbus* (Shine and Allen 1980) although in that case the two snakes were recorded as rapidly writhing and moving and striking at each other. No such behaviour was observed in the present bout although this may simply reflect the relatively short period of observation coupled with the obvious disturbance of a vehicle passing over the top of snakes. One of the snakes was

observed to have a wound approximately 15 cm behind the head (Figure 1) but the origin of this wound is unknown. It is unlikely that this wound originated from being struck by the other snakes as Shine (1991) records that generally males do not bite each other during these encounters. Biting has been recorded during combat between males of the red-bellied black snake *Pseudechis porphyriacus* (Shine 1981) and also in captive childrens pythons and black-headed pythons (Shine 1991).

Male combat is widespread in Australian elapids with Shine (1991) listing this behaviour for species of blacksnakes *(Pseudechis)*, whipsnakes *(Demansia)*, white-lipped snakes *(Drysdalia)*, brown snakes *(Pseudonaja)*, taipans *(Oxyuranus)*, swamp snakes *(Hemiaspis)*, small-eyed snakes *(Cryptophis)* and tigersnakes *(Notechis)* as well as copperheads *(Austrelaps)*. The form of the combat is similar in most species with entwining of a portion of the bodies usually observed. Combat is usually recorded during the mating season with the current observation being no exception. Highland copperheads mate in spring and autumn (Shine 1977) which coincides with the late summer/early autumn timing of the current observations. Further observations are necessary to document the full combat behaviour in this species.

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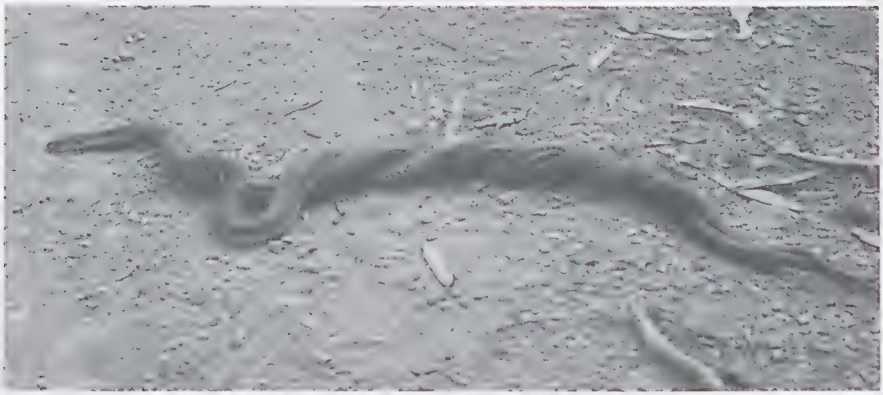
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Figure 1. Entwinement of the bodies of *A.ramsayi* during male combat.



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DIET OF THE SOUTHERN ANGLE-HEADED DRAGON *HYPSILURUS SPINIPES*

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ABSTRACT

Field observations and scat analysis show that the diet of *Hypsilurus spinipes* consists primarily of ants as well as butterfly larvae and other invertebrates. An ambush method of prey capture, and drinking behaviour are also described.

INTRODUCTION

Dietary information for *Hypsilurus spinipes* in the field is scant. Most observations are based on dragons in captive situations where the diet consisted of live insects, worms, snails, slugs and young mice (Longley 1943, Webb 1984). This report is based on field observations, scat analysis and feeding trials of free roaming individuals.

METHODS AND MATERIALS

Spooling (Manning & Ehmann 1991) was used to monitor the movements of individual dragons within Wild Cattle Creek State Forest and other forest areas around Coffs Harbour, NSW. Spooling also enables location of scratch and forage sites to be studied. During the attachment of spool packs, dragons occasionally defaecate, thus providing access to scats for analysis.

A hide was employed for behavioural observations, which allowed the discovery of their ambush method of catching insects. Their drinking behaviour and their feed species, were also observed.

To test whether the species was omnivorous some feed trials were conducted. Items of various food types were attached to thin cotton, and secreted in the leaflitter. I waited 3-5 minutes after returning to the hide before moving the food items along the leaf litter by slowly pulling on the threads. This food trial technique was conducted on four adult males, one sub-adult male and one female.

RESULTS

Examination of 16 scats from nine individuals revealed large numbers of ants with up to 9 species distinguishable per scat (D. Horning, pers comm). In 13 scats ant body parts (head capsules, thorax, and legs) were the only identifiable component. In 3 scats beetle forewings or head capsules were present as were cockroach forewings and legs. Scats were generally quite moist, unlike scats from *Amphibolurus muricatus, Physignathus lesueurii,* or *Pogona barbata* (pers obs.).

Prey items eaten by dragons under observation consisted of beetles (predominately Scarabidae and Passalidae), earthworms, grasshoppers, spiders, ants, moths and butterfly larvae.

On five occasions adult males have been observed dropping up to 1.4 metres from branches to within 10cm of an insect prey item on the ground, enabling them to quickly grasp the insect before it retreated back into the leaf litter.

One female dragon climbed 1.6 metres up a forest oak *(Allocasuarina tortulosa)* where she ate a butterfly larva *(Hypochrysops sp.)*. The larvae of this genus are usually attended by ants, and during the day are often found in the ants' nests at the base of the food plant or in cracks and crevices of the food plant (Common and Waterhouse, 1981). The female then consumed the ants which came to tend the now non-existent larva. Another female located on a forest oak

had both ants and butterfly larva *(Hypochrysops sp.)* still in her mouth when she displayed while having her spool pack replaced.

All dragons subjected to food trials showed no sign of interest in the food items when they were stationary, but the stimulus to feed was increased by movement of the food item. Taste rather than shape of the food item was an important factor in food selection, as the dragons grasped squares of apple and circles of banana, but did not consume them. Prior experience with prey may also influence selection as no dragons grasped or showed any interest in centipedes. (See Table 1 for results). The single female in the food trials showed little interest in the food items moving on the ground, but would grasp them if they were moving up the sapling where she was located.

Table 1. Food Trials with *Hypsilurus spinipes*

FOOD	DRAGON					
	1	2	3	4	5	6
Newborn Mice	GRA	GRA	CON	GRA	GRA	NIS
6-10 day old Mice	GRA	GRA	GRA	GRA	NIS	NIS
Lampropholis delicata	NIS	NIS	GRA	GRA	NIS	NIS
Worm	CON	CON	CON	CON	CON	CON
Grasshopper	CON	CON	CON	-	CON	CON
Mealworm	CON	CON	CON	CON	CON	CON
Banana (cut in circles)	GRA	-	GRA	GRA	GRA	GRA
Apple (cut in squares)	GRA	NIS	GRA	GRA	GRA	GRA
Centipede (live)	NIS	NIS	NIS	NIS	NIS	NIS
Freshwater Fish	GRA	GRA	GRA	NIS	NIS	GRA
Snail (live)	NIS	NIS	GRA	GRA	GRA	NIS

KEY

Dragons 1-4 *Adult Male*
Dragon 5 *Sub adult male*
Dragon 6 *Adult Female*

No animal food item was alive at the time of presentation (except where noted)

GRA : *Food grasped but not consumed*
NIS : *No interest shown in food*
CON : *Food grasped and consumed*
- : *Food not tried with that individual*

During periods of rain both males and females normally descend to the ground to drink. Dragons were observed laying flat against the substrate (generally in a depression where water had gathered). Water was drawn into the mouth, without obvious head movement and only slight jaw movement. Longley (1943) noted similar behaviour in captives. A side to side movement of the head with the labial surfaces brushing against damp leaflitter was observed if puddles of water were not available. Licking of raindrops was observed during or shortly after rain showers.

Ehmann (1992) describes an alternative behaviour: "drinks water running down branches during rain, water is gravity fed into the mouth, only very small head and jaw movements were made".

CONCLUSION

Hypsilurus spinipes is primarily insectivorous, unlike its congener *H. boydi* whose wild diet consists of invertebrates, birds (Zwinenberg 1974), snails, slugs and soft rainforest fruits (Covacevich & McDonald 1991), and captive diet of fish and *Phyllurus cornutus* eggs (Barnett 1981). There was no evidence of omnivorous or carnivorous feeding by *H. spinipes* from field observations or scat analysis and only one instance with the feed trials.

The captive diet of *Hypsilurus spinipes* includes mice, snails and slugs, earthworms and insects (Webb 1984), but during the feed trials of wild individuals, only one dragon consumed anything other than invertebrates.

It is unknown whether the moist scats observed with this species are a reflection of the amount of soft bodied animals eaten (e.g. earthworms and caterpillars), or whether water conservation is not as critical in the enclosed forest habitat as opposed to more open habitats.

Almost all observations of females feeding have been arboreal; the female in the food trials showed similar behaviour. This, combined with their high degree of arboreal movement (Manning and Ehmann, 1991), would suggest that males and females exploit different niches within the habitat, enabling higher populations of dragons to inhabit an area as the sexes are not competing for the available food resources.

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THE REDISCOVERY OF THE ENDANGERED SPOTTED TREE FROG *(LITORIA SPENCERI)* IN NEW SOUTH WALES AND SOME SUBSEQUENT FINDINGS.

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INTRODUCTION

The occurrence of the Spotted Tree Frog in New South Wales has to date been based on a single specimen taken and photographed by Hal Cogger at Bogong Creek (Alpine Way bridge) Kosciusko National Park during early January in 1970 or 1971 (Cogger 1992, and pers comm. 1993). Recent intensive field work in Victoria has confirmed the decline or apparent disappearance of this species at many sites. (Watson et al 1991, Gillespie 1992).

Despite thorough searches by several workers in the intervening years in New South Wales no further specimens were detected. On 30 December 1992 we found a substantial population of this species on Bogong Creek at a site (altitude 1090m) approximately 12 km north and upstream from the Alpine Way bridge. This paper reports the rediscovery and presents preliminary findings resulting from this rediscovery.

MATERIALS AND METHODS

We visited the Khancoban area between 27 December 1992 and 6 January 1993 and examined 9 access points at 5 different water courses (including three points on Bogong Creek). These sites were chosen using 1:50,000 topographic maps of the region. From previous visits in 1987 and November 1992, from field work experience with the Spotted Tree Frog at the Taponga River in Victoria (by HE), and using additional habitat information kindly provided by Graeme Gillespie, we were able to assess each of the 9 access points for the likely occurrence of the species. Water and air temperatures were measured with a laboratory grade fine/bulb mercury-in-glass thermometer. Rock surface temperatures were measured by applying the same thermometer to the rock with a small blob of plasticine then waiting for 3 minutes before reading. Photographs were taken with an Olympus OM2 System.

Live specimens were temporarily held in 37 micron clear polythene bags approximately 30 cm wide x 50 cm deep for scat collection and for transport. Transported and held frogs were transferred into labelled new bags at least every two or three days (or after scat removal) to ensure cleanliness. A small amount of fresh water was added at each bag change and this provided the frogs with free water and adequate humidity. Bagged frogs were at all times kept in cool conditions (range 6 to 21°C) either indoors, within a styrofoam box (during transport) with a heat sink of cool water (minimum 8°C), or in a refrigerator (minimum 6°C). This temperature range is easily within the wider range of temperatures the species may experience in the wild.

Snout-urostyle lengths (SUL to the nearest 0.5 mm) were taken in the field by direct measurement or by use of a marker sheet from which measurements were later taken with a clear plastic ruler (this latter technique was used for specimens measured and immediately released at their capture sites). Weights of frogs were determined with a portable electronic balance. Scats were preserved in 10% formalin and analysed with a binocular microscope.

Two adult specimens were added to the collection of the Australian Museum (AM) and furthermore tissues from them were added to the deep frozen tissue bank at the AM. Their

tissue register numbers are NR1841 and NR1842. Following tissue removal these specimens were examined for their reproductive condition.

OBSERVATIONS

On arrival at the site at 1600 hours on 30/12/92 two of us (JE & NE) found an access track to the creek and within a minute of moving about on emergent rocks in the flowing watercourse (JE) found a juvenile frog on a medium-sized emergent rock and (NE) also saw another similar-sized juvenile. Both knew of the importance of the Spotted Tree Frog, that it had not been reported in the area for about 20 years, and that we were hoping to find the species. They hurried back excited with their news. (HE) examined and (with extreme delight!) confirmed that the juvenile frog was indeed a Spotted Tree Frog.

Subsequent searching in fine sunny weather for a further 2 hours along approximately 100m of the stream resulted in the discovery of a total of 3 juveniles (SUL 17.0, 18.5 and 20.0 mm and 0.50, 0.60, 0.75 g respectively), 2 subadults (SUL 27.5 and 31.0 and 1.60 and 2.25 g respectively) and 2 adult males (SUL 37.0 and 38.5 and 4.30 and 4.60 g respectively). All these frogs were basking in direct or diffused (through overhead leaves) sunlight while sitting on emergent medium to large rocks in mid stream despite the abundance of shaded perching sites. The juveniles, subadults and adults were each respectively clustered (i.e. the juveniles were within 2 metres, the subadults within 10 cm and the 2 adult males within 5 cm of each other). The rock surface temperatures where the frogs were basking ranged between 26.8 and 29.0° C while air temperatures (dry bulb) ranged from 23.5 to 25.2° C and the water temperature (flowing) in the immediate vicinity of the frogs varied between 14.2 and 17.0° C.

One of the subadults and one of the adults initially escaped into slow moving and faster flowing water respectively both swimming downward with powerful hind leg kicks and forelimbs outstretched until contact with the substrate (pebbles and larger stones) was made. Both frogs then sought out narrow spaces between stones by hand/forelimb spanning movements that appeared to gauge the size of the refuges. The recesses that both came to rest in allowed each frog to lightly anchor itself within by making contact with three limbs. They remained submerged and motionless in these positions with apparently closed eyes for up to five minutes of observation before being recovered for measurements.

During a subsequent visit on 3 January 1993 (by JE & HE) between 22h30 and 02h30 next morning (at 0h30 dry bulb temperature was 13.0° C, wet bulb temperature was 12.0° C and water temperature was 13.0° C) a total of 19 frogs were measured: 9 presumably males (3 of which had fully pigmented nuptial pads), 7 large females (2 of which were obviously gravid while 3 were definitely flaccid) and 3 immature specimens of SUL = 36.4 mm (range 35.5 to 40.5), SUL = 53.6 mm (range 46 to 57), and SUL = 32.2 (range 30.5 to 34.5) respectively.

Of these 19 frogs all females were in close proximity (within 30 cm) of rapids or racing water with surface turbulence, while all but two of the males were in similar situations. These two males and the 3 immatures were sitting on emergent rocks in almost still and slower flowing water respectively. In addition to these 19 measured frogs there were a further 12 individuals seen (mostly adults which were either not disturbed or which escaped into fast flowing water): this made a grand total of 38 frogs in a stretch of about 240 metres along the creek.

Two other species of tree frogs were found in the area. The Alpine Tree Frog *(Litoria verreauxii alpina)* was abundant in a swampy area about 0.8 km upstream (based on the enormous numbers of tadpoles and metamorphs found in still pools, and on the number of calling males heard). Four specimens of calling male Leaf Green Tree Frogs *(Litoria phyllochroa)* were found at night in the creek (all were within 3 to 4 metres of a Spotted Tree Frog): the former were calling while sitting on large emergent rocks in or around relatively quiet larger pools of water. In total seven calling frogs were heard on the creek (4 were sourced to Leaf Green Tree Frogs). The remaining 3 could not be found due to their reluctance to continue calling, but their calling

site (a still large pool) suggests they also were *Litoria phyllochroa*. The call of the Spotted Tree Frog is very similar to that of the Leaf Green Tree Frog (based on a tape recording of the latter species kindly provided by Murray Littlejohn).

A small side pool (approximately $2m^2$) connected to the main stream by an irregular narrow and shallow channel averaging 50 cm long x 10 cm wide x 2 cm deep contained the only tadpoles seen in the creek despite intensive searching both during the day and at night. The connecting channel had its opening into a quieter section of the creek slightly downstream of the side pool, and both the pool and channel had a basement of small to medium rocks and pebbles which were patchily covered in a fine thin deposit of flocculating silt. There were about 25 to 30 small tadpoles (14 to 17 mm total length, Gossner stage 25) quietly grazing on the rocks between and at the edges of the patches of sediment. Some tadpoles were also feeding amongst an open mass of exposed fine brown plant roots at one side of the pool. Two of these tadpoles metamorphosed as Spotted Tree Frogs in mid-February 1993 (under culture conditions). The tadpoles were found and observed only during the last night's work.

A photograph of a large gravid female Spotted Tree Frog from this study site is on the front cover of this issue of Herpetofauna.

The two specimens added to the collection of the Australian Museum were a male (SUL 38.5 mm, with darkened nuptial pads, and large testes) and a female (SUL 52.0 mm, with ovarian eggs at various stages of development from small to large apparently almost ripe ova).

DISCUSSIONS

It is a pleasure to report the finding of this substantial and apparently healthy population which confirms the occurrence and persistence of the Spotted Tree Frog in New South Wales. This population includes all stages from tadpoles through juveniles (probably last season's metamorphs) to subadults (possibly representing 1 to 2 year old individuals) and adults (presumably 2 and more years old). Of particular interest is the presence of most post-metamorphic stages in close association with the creek: it seems that at least some individuals of non-reproductive stages remain in the immediate vicinity despite the existence of extensive apparently suitable vegetation and other substrate in which to forage. This association may reflect a dependence on free water for regular and frequent access to rehydrate, for specific stream-adapted prey (this may explain the association of adult frogs with rapids and turbulent waters), avoidance of some predator or competitor that occurs in the surrounding dense vegetation, or the limitations imposed by other physiological or morphological characteristics (e.g. extensive and complete hind foot webbing which might tear if snagged in the abundant sharp sclerophyllous vegetation).

The observations clearly support the suggestion that the Spotted Tree Frog thermoregulates possibly by basking and definitely by sitting on quite warm rock surfaces (26.8 to 29.0° C) that have been or are exposed to direct or partly diffused sunlight. Those frogs actually seen with sunlight falling directly onto them (late afternoon) were facing the sun (2 subadults and 2 adult males) or had no apparent orientation (2 juveniles). Diurnal thermoregulation by this alpine frog would aid digestion but would also expose it to increased ultraviolet radiation damage and increased dessication. The latter tendency may in part explain their water dependence.

The apparent lack of calling by male Spotted Tree Frogs despite their reproductive fitness and the presence of gravid females is puzzling, unless the species had already finished breeding. The creek was "ear-holed" (as opposed to "eye balled") on two evenings between 1800 and 2030 hours for at least 8 minutes at two and three sites during warmish moist weather conditions as well as the longer night observations started on 3.1.93.

The only tadpoles found in the side pool may represent an aberrant oviposition site and time (albeit fortunate for us) as no other similar pools (about 15 seen) had tadpoles. They are clearly lentic, and in culture they are extremely cryptic especially by day or when illuminated. They

spontaneously swam into the accessible spaces between pebbles and under the edges of large submerged rocks placed into the culture container, more so as they became larger (even at Grossner stage 38 i.e. toes discs and webbing fully developed).
This behaviour may partly explain the difficulty workers have experienced in finding tadpoles: there are millions of such refuges in which thousands of tadpoles would be lost. To make tadpole spotting more difficult the water surface in these creeks is rarely still: the surface aberrations due to water flow and disturbances even in less turbulent waters would effectively obscure such generally cryptic, thigmophilic tadpoles.

The analysis of the limited sample of faeces (scats) collected from a total of six Spotted Tree Frogs (Table 1) indicates an exclusively insectivorous diet (no spider legs or fragments were found) with a predominance of flying forms. The faecal analysis used does not readily allow the detection of soft-bodied prey.

The finding of this substantial single population of the Spotted Tree Frog is a welcome plus for the conservation of this species. Further field work will be carried out in late February to increase our knowledge of this population and hopefully find other populations in the district.

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Table 1: Analysis of faeces (scats) of 6 Spotted Tree Frogs of 3 different sizes. Scats collected Bogong Creek, Kosciusko National Park, in period 30.12.92 to 4.1.93.

FROG SIZE AND NUMBER	FAECAL FRAGMENT IDENTIFICATION (number of individual insects of each insect prey species)
Juveniles (2)	8 small diptera (fly); species D1 3 small coleoptera (beetle); species C1 unidentified insect fragments (mostly legs)
Subadults (2)	10 medium diptera; species D2 12 small coleoptera; species C2 3 medium coleoptera; species C3 unidentified insect fragments
Adults (1M + 1F)	5 large diptera; species D3 2 medium coleoptera; species C4 1 medium coleoptera; species C3 3 medium coleoptera; species C5 1 medium lepidopteran (moth) 1 medium hemipteran (bug)

GROWTH AND SEXUAL DIMORPHISM IN SIZE AND TAIL LENGTH IN *TYMPANOCRYPTIS ADELAIDENSIS ADELAIDENSIS* (LACERTIA: AGAMIDAE)

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INTRODUCTION

Tympanocryptis adelaidensis is a small (up to 52mm snout-to-vent length), terrestrial agamid of the mid-west and lower west coast of Western Australia, from approximately 26°S to 32°S (Storr *et al.* 1983). It is associated with sandy soils (Cogger 1976), breeds in spring (Davidge 1980) and can be assumed to be an insectivore. The species is sexually dimorphic, femoral pores being well developed in males but small or absent in females. Males are also strongly marked with black patterning on the ventral surface, whereas females are only indistinctly marked ventrally, if at all (Storr *et al.* 1983). Like many of Australia's small lizards, however, even fundamental aspects of the biology of *T. adelaidensis* are unknown. The purpose of this paper is to begin to fill this gap by presenting information gathered in the course of two fauna studies conducted within the range of *T. adelaidensis.* This includes: data on growth rates and age at sexual maturity from recaptures of marked individuals; data on sexual dimorphism in size and tail length from one population.

METHODS

Data on *T.adelaidensis* were collected at two sites: Mooliabeenee (31 deg 20'S, 115 deg 44'E) from March 1983 to March 1986 and: Cooljarloo (30°37'S, 115°25'E) from August 1989 to November 1991. Both sites consisted of banksia woodland on sand, the woodlands being lower (under 4m) at the more northerly site. Studies at both sites involved long-term programmes of pitfall-trapping and mark/release/recapture of all small vertebrates, including *T.adelaidensis.*

Specimens of *T.adelaidensis* were individually marked by toe-clipping and measured (snout-to-vent length (SVL) and total length) to the nearest mm by being pressed against a clear plastic ruler. Specimens were sexed by the presence/absence of femoral pores. Some specimens were not sexed when femoral pores were indistinct and ventral colouration unhelpful. Most data presented in this paper were collected at Cooljarloo, where field trips occurred on a seasonal basis (ie four times a year) and sampling effort was the same each season. Field trips were monthly at Mooliabeenee but *T.adelaidensis* was less often caught at this site.

Presentation of Results

Sexual dimorphism in SVL is examined for the Cooljarloo population only. Data from February and November are presented separately. Male and female distributions of SVL are compared using student's t-test.

Tail length is examined as a proportion of SVL for the Cooljarloo population only. Seasonal, sexual and age samples are treated separately. Specimens were aged as adult if they equalled or exceeded an SVL of 36mm (males) or 40mm (females) (see Discussion). Student's t-test is used to compare pairs of distributions between sexes, ages and seasons.

Growth in SVL of recaptured specimens is plotted against the month of capture and the known or estimated age of the specimen. Recaptured specimens from both Cooljarloo and Mooliabeenee are used for this analysis. Specimens first caught when close to the minimum SVL for T.adelaidensis can be precisely aged, assuming hatching occurs in late summer when such small specimens first appear. Specimens first caught when greater than the minimum SVL can

be assigned a minimum possible age by the relationship of their SVL and their growth with those of specimens of known age.

RESULTS

Distributions of SVL are presented on Figure 1. Males dominated captures in November but not in February. Distributions in February samples were bimodal for both sexes but the smaller size class present in February was absent in November. Only three specimens, all males, were caught in August. They had SVL's of 34, 35 and 36mm, intermediate between the smaller male size class of February and the larger male size class of February and November. In the November sample, males were significantly smaller than females (mean male SVL 41 mm; mean female SVL 46mm; $T = -8.537$, $P < 0.0005$).

Data on tail length as a proportion of SVL are presented and analysed in Table 1. Adult males were proportionately longer-tailed than adult females in November and February and immature males were proportionately longer-tailed than immature females in February. Adult males in November were also proportionately longer-tailed than either adult or immature males in February, males having similar proportional tail lengths in February whether adult or immature. Adult and immature females were similar in proportional tail lengths in November and February samples.

Growth data from recaptured specimens are presented on Figure 2. Most specimens were adults when first caught and displayed little growth. Only two specimens first caught when immature and probably about 1 month old (in February) were subsequently recaptured. The male had reached the estimated size at sexual maturity by August of the same year, while the female was close to the size at sexual maturity by November of the same year. The oldest specimens of both sexes had minimum ages of two years.

Most recaptures were made in spring and therefore provide little information on seasonal variation in tail length in males. An immature male caught in February and subsequently recaptured in August had the same proportional tail length (1.44) on each occasion. This is shorter than all but 10 of the 125 adult males measured in November. The other two males caught in August had proportional tail lengths of 1.46 and 1.59.

DISCUSSION

The greater number of male than female *T.adelaidensis* caught in November probably represents a sampling bias rather than an imbalance in the population; males may move around more than females at this time of the year and therefore more readily fall into pitfall traps. Davidge (1980) also recorded more male than female *T.adelaidensis* in a study using pitfall traps. Although she did not present a seasonal breakdown of captures, they were probably concentrated in spring as occurred at Cooljarloo. The lower number of captures in February also suggest that activity and hence likelihood of capture are reduced at this time, although the adult population may decline after breeding due to post-breeding mortality, recorded in some other small agamids (Heatwole 1976).

Both sexes in T.adelaidensis appear to reach maturity in their first year although an unusually small female caught in November may have been too small to breed. Individual variation in growth rate in lizards may result in individuals achieving sexual maturity in different years (Bustard 1969). Sexual maturity is reached in the first year of life in at least three other small, Australian agamids: *Ctenophorus fordi* (Heatwole 1976), *Ctenophorus maculosus* (Mitchell 1973) and *Ctenophorus isolepis* (Pianka 1971). In *C.fordi* and *C.isolepis,* however, populations are essentially annual, whereas in *T.adelaidensis* several recaptured specimens reached an age of two years. The distributions of SVL's in the samples of male and female *T.adelaidensis* further suggest that the population is not replaced annually. In both male and female samples, individuals considerably larger than the minimum SVL at maturity are well represented.

The difference in longevity between *T.adelaidensis* and these similar-sized agamids may be related to climatic restrictions on reproduction, although clearly factors such as predation and disease must not be discounted. Reproduction in *T.adelaidensis* is strictly seasonal (Davidge 1980). This, together with the seasonal emergence of young in late summer, suggests that females are single-brooded. In contrast, *C.fordi* and *C.maculosus* have extended breeding seasons and are multiple-brooded (Heatwole 1976, Mitchell 1973). These three species probably have similar brood sizes, so *T.adelaidensis* may therefore have lower fecundity than *C.fordi* and *C.maculosus*. The greater longevity of *T.adelaidensis* than of *C.fordi* and *C.maculosus* could be a strategy to cope with this lower annual fecundity. Davidge (1980) concluded that strictly seasonal breeding in all reptiles at her study site was due to the limitations of a mediterranean-type climate. Low winter temperatures and the annual summer drought may be responsible for restricting the breeding season and limiting species such as *T.adelaidensis* to single broods.

Growth of *T.adelaidensis* is very rapid in the first year but slight in the second. On the basis of dissections, Bamford (1986), found that the smallest mature male specimens had an SVL of 36mm, the corresponding value for females being 44mm. The value for males agrees with the SVL distribution for males in November, but the value of females is probably an overestimate, with 40mm demarcating all but one (aberrant or incorrectly sexed?) specimen. Variation in SVL and in growth rates among the mature specimens that were recaptured could be due to differences in age (large specimens could be more than the conservative ages ascribed to them), to individual variation or to physiological differences in growth. Bradshaw (1971) found that a population of *Ctenophorus ornatus* contained individuals of fast and slow growth physiologies. Among males of *C.fordi* there were differences in fat deposition and duration of sexual activity (Heatwole 1976). Such differences were not apparent in *T.adelaidensis* but could result in some of the observed variations in growth.

In many species of reptiles, greater size in males than females is associated with male territoriality and aggression (Shine 1985). As male *T.adelaidensis* are smaller than females, this suggests that such behaviour is not well developed in this species. It is well known that both brood and egg size correlate positively with maternal body size however (Shine 1985). The larger-bodied female than male *T.adelaidensis* therefore probably reflect selective pressure for the production of more or larger young.

The greater proportional tail length of sexually active males than females or sexually inactive males suggests that elongation of the tail is associated with sexual activity, possibly the enlargement of reproductive glands. Tail length is proportionally greater in many male Chelonia (Obst 1986) and Serpentes but variation in tail length with reproductive condition has not been reported.

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Table 1. Means and standard deviations of tail length as a proportion of SVL in adult and immature male and female T.adelaidensis measured in November and February. Values are compared using student's t-test.

Sex and Age	Month of Sample	
MALES	November	February
Adult	n: 125 $\bar{x}$: 1.64 s: 0.130	n: 7 $\bar{x}$: 1.53 s: 0.113
Immature		n: 13 $\bar{x}$: 1.46 s: 0.076
FEMALES		
Adult	n: 33 $\bar{x}$: 1.38 s: 0.0715	n: 9 $\bar{x}$: 1.39 s: 0.0841
Immature		n: 10 $\bar{x}$: 1.38 s: 0.0519

Statistical Comparisons

Adult males November to adult females November	T = 11.017. P 0.0005
Adult males November to adult males February	T = 2.187. P 0.025
Adult males November to immature males February	T = 4.878. P 0.0005
Adult males February to immature males February	T = 1.655. Not significant
Immature males February to immature females February	T = 2.837. P 0.005

Figure 1. Snout to vent length distributions in February and November samples of *T.adelaidensis* from Cooljarloo.

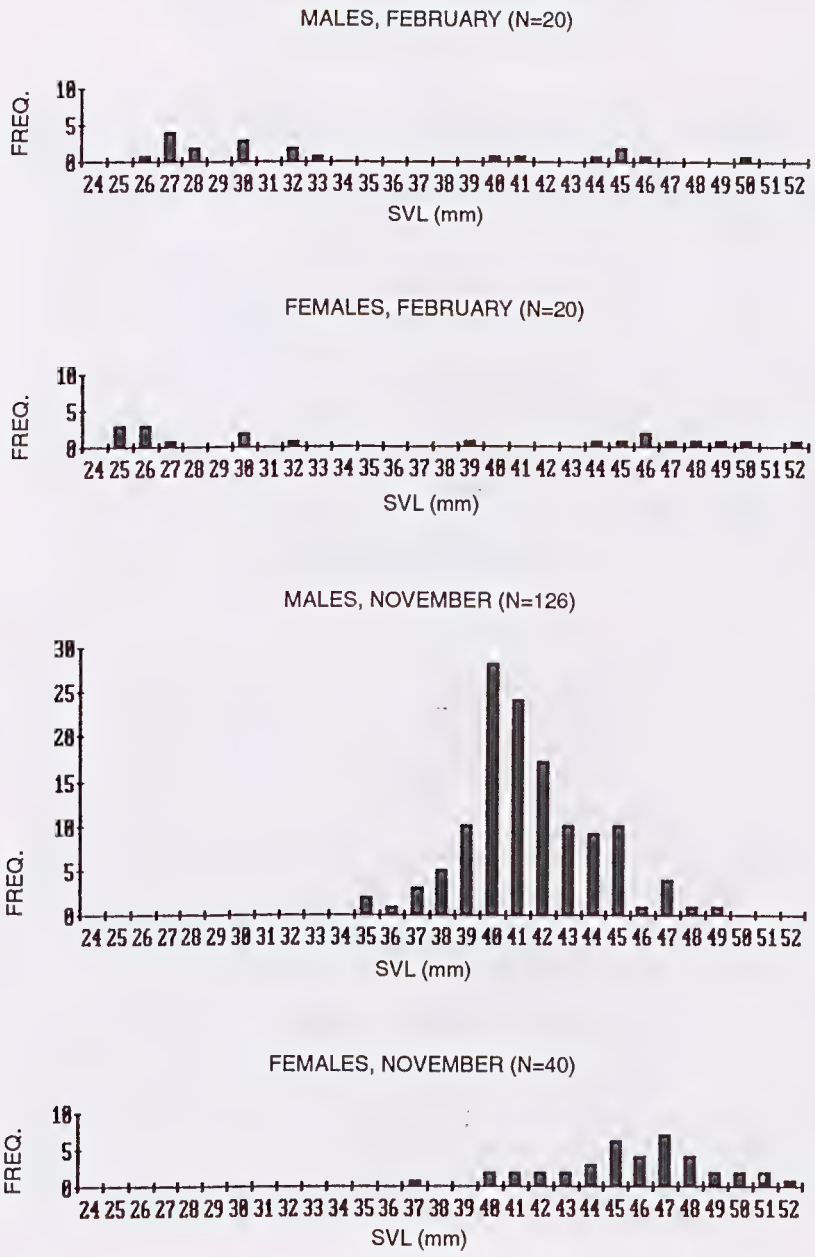
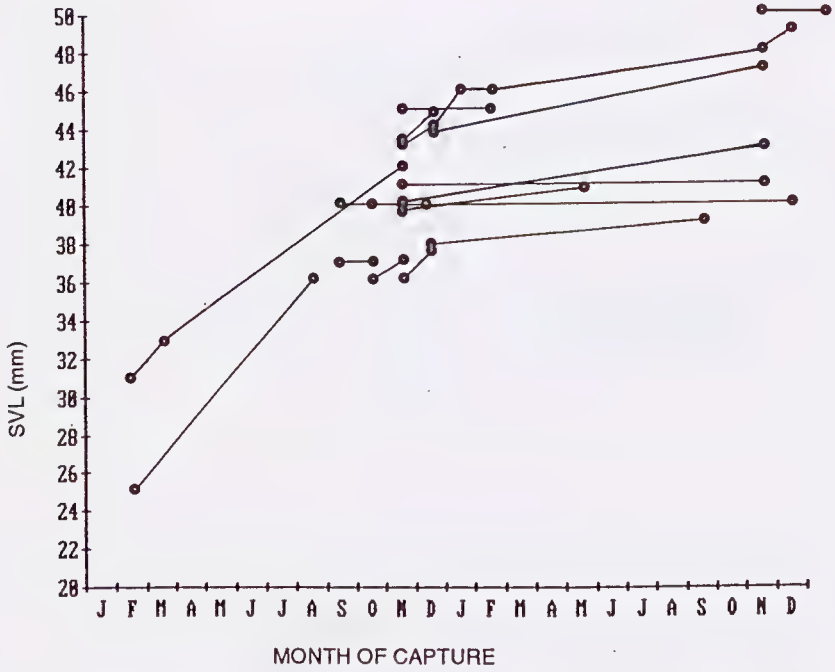


Figure 2. Changes in SVL of recaptured *T.adelaidensis* from Cooljarloo and Mooliabeenee. Specimens first caught as adult were conservatively aged by the relationship of their SVL and month of capture with those of specimens of known age.



A DIFFERENT FEEDING STRATEGY IN THE STRIPED SKINK *(CTENOTUS UBER ORIENTALIS)* FROM SOUTH AUSTRALIA

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Storr *et al* (1981), Cogger (1987), Wilson & Knowles (1988) and Horner (1992) reveal *Ctenotus* to be the largest genus of reptiles in Australia. *Ctenotus* are generally diurnal, sun loving and largely terrestrial with the occasional species climbing hummock grass or low shrubs when a particularly attractive prey item presents itself (Greer, 1989). Detailed studies to date include Pianka (1969) (a, b and c), Pough (1973), and James (1991). This genus tends to operate at high temperatures, with an average active body temperature of between 30-38°C and critical lethal maximum temperatures of between 42.5 - 45.5 °C (Greer, 1989).

The diet of the *Ctenotus* genus is poorly known. Some studies have shown the significance of termites in the diets of five species of *Ctenotus* in arid Australia and confirmed that at least one species *(C. pantherinus)* specialised in termites. It has also been shown how the diets of these animals changed seasonally, with differences in some species being quite marked (Pianka 1969, James 1991). For example, *C.helenae* during spring consumed spiders, ants and cockroaches, but when environmental conditions were at their driest (i.e. autumn) the diet was predominantly termites. *Ctenotus* are recorded by Pianka (1969) as opportunistic predators, but some are known to take more than 10% plant material by volume (Greer, 1989). Pough (1973) reports that larger species of lizard in general, eat more plant material. Swan (1990) includes in the diet of this genus in New South Wales insects, spiders, cockroaches, bugs, wasps, ants, termites, beetles and other arthropods, and in the case of *Ctenotus robustus*, also small skinks. *C.uber* is known to be predominantly insectivorous (Swan 1990). *Ctenotus uber orientalis* (Storr 1969) is described as averaging 70 mm snout-vent length, the tail is 157 - 238% of SVL (Storr *et al*, 1981).

On Wednesday 20th November 1991, at Mt Mary (34° 06'S, 139° 26'E) SA, a small *C.u.orientalis* was observed darting between small ruby salt bushes *(Enchylaena tomentosa)* in a heavily grazed paddock. On Thursday 21st November at 12:24 hours, whilst following Sleepy Lizards *(Tiliqua rugosa)* fitted with radio transmitters (Bull *et al*, in press) another *C.u.orientalis* was seen to emerge from a refuge beneath a salt bush and move to another salt bush, which it climbed to a height of 500 mm. This specimen was observed to pick two red berries off the bush then climb down and moved 2.5m to another bush where it again climbed to 300 mm and ate another red berry. This animal was watched for 25 minutes as it foraged for berries, during this time it climbed nine blue bushes and ate approximately seven berries. This included the abovementioned three berries from two bushes. It was interesting to note that the animal went directly to each bush, thus must have been able to discern this bush from others of the same and other species which were not fruiting. Seven berries, all larger than the head of a match, consumed by this skink (SVL 50 mm) is a substantial quantity of food. These observations occurred at the end of spring just as the hot summer weather was setting in (i.e. >35°C midday air temperature), and within three days after light rain had fallen. A search of all individual ruby salt bushes in the area in which the skink had foraged revealed no further ripe orange/red berries, reinforcing the suggestion that this animal may be aware if this particular food item was present or not. Alternatively, a cue as to the availability of the berries may be a response to olfactory and/or visual signals regardless of when the plants have berries as not all bushes the animal climbed had berries. Circumstances did not permit further observations of this *C.u.orientalis* population. However the observations indicate that at certain times of the year vegetable matter may be an important part of the diet in at least one species of *Ctenotus.*

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Figure 1. Adult *Ctenotus uber orientalis*



NOTES ON INCUBATION AND EARLY GROWTH IN THE WEASEL SKINK, *LAMPROPHOLIS (= SAPROSCINCUS) MUSTELINA*

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INTRODUCTION

The Weasel Skink *(Lampropholis mustelina)* is a small, diurnal lizard occupying a variety of habitats in the ranges and adjacent coastal areas of New South Wales and eastern and southern Victoria (Cogger, 1986). Although a common species, documented records of its life history are almost totally restricted to instances of communal egg-laying (German, 1986; Greer, 1989) and winter aggregation (Swan, 1988).

A nest of 69 skinks eggs, and their accompanying soil and leaf litter, was donated to Melbourne Zoo on 10 January, 1991. The eggs were incubated and growth data obtained on six young lizards.

MATERIALS AND METHODS

Eggs and young lizards were measured with vernier callipers to 0.1mm and weighed on an AND electronic balance (FY-3000) to 0.1g. The eggs were incubated on the accompanying soil and leaf litter mixture in a sealed plastic container, which was placed in an Isolette Infant Incubator (Air-Shields C300) at 27-29°C.

Six young lizards were raised in a 45 x 20 x 25cm glass aquarium, which contained a thin layer of aquarium gravel, pieces of bark and a small water bowl. It was placed on a shelf inside an east-facing window in an unheated office, where the ambient temperature ranged from 6-16°C in the winter (June-July) to 12-35°C in summer. The lizards were fed 2nd and 3rd instar crickets *(Teleogryllus oceanicus)*, dusted with Vionate and calcium carbonate, every three days when the temperature exceeded 15°C.

RESULTS

Ten eggs were measured on arrival, with the mean weight being 0.31g, length 10.70mm and width 6.61mm. Fifty-four of the eggs hatched 18-24 days after arrival at the Zoo.

The six young lizards retained were most active when the tank received direct sunlight and the temperature was 20-26°C, and grew slowly but steadily (Figs 1 and 2). One died on 4 June, 1991, and a second on 5 January, 1992; neither appeared to have suffered from aggressive encounters and were feeding in the week prior to death. Monitoring of the surviving individuals ceased at 12 months of age.

DISCUSSION

There are only two previously documented life history characteristics for *L.mustelina,* i.e. Ehmann (1988) records a mean egg weight of 0.17g and German (1980) a hatchling total length of 41mm (36-44, n=12). Hence, the data recorded in this study are within the known ranges, poorly documented though they may be. They are also within the known ranges for other members of the genus *Lampropholis*, i.e. incubation time for *L.delicata* and *L.guichenoti* (Shine, 1983), attainment of sexual maturity in *L.guichenoti* (Simbotwe, 1985) and dimensions of eggs and hatchlings in *L.delicata* (pers. obs).

ACKNOWLEGEMENTS

Staff of the Melbourne Zoo Herpetofauna Department assisted with the maintenance of the lizards.

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Figure 1. Increase in weight from hatching to 12 months of age for *Lampropholis mustelina* at Melbourne Zoo (horizontal bar is mean, vertical line is range; data are for six lizards from hatching to 4 months, five lizards from 5-10 months and for four lizards from 11-12 months).

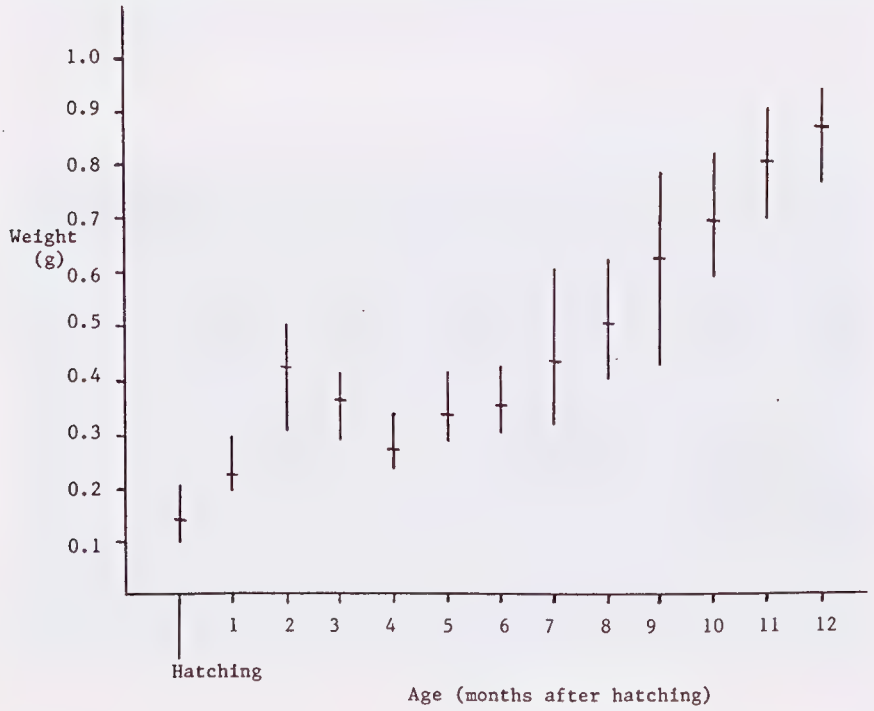
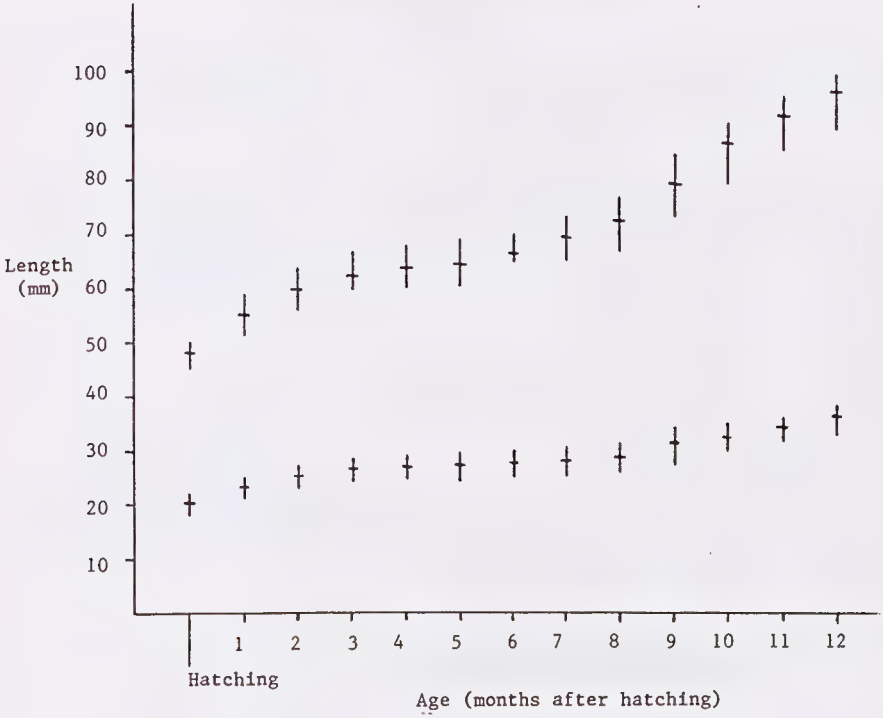


Figure 2. Increase in length (upper data set for total; lower data set for snout-vent) from hatching to 12 months of age for *Lampropholis mustelina* at Melbourne Zoo (horizontal bar is mean; vertical line is range; data are for six lizards from hatching to 4 months, five lizards from 5-10 months and for four lizards from 11-12 months).



A SURVEY OF THE REPTILES OF THE COBBLER CREEK RECREATION PARK, SALISBURY EAST, SOUTH AUSTRALIA

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ABSTRACT

The main purpose of this field work was to undertake a survey of the reptiles occurring in the Cobbler Creek Recreation Park. Over a 30 month period, 20 species of reptile were identified.

INTRODUCTION

The Cobbler Creek Recreation Park is a newly proclaimed recreation park under the National Parks and Wildlife Act. It is situated approximately 19 kilometres north-east of Adelaide on the hills face zone. It comprises about 288 hectares, ranging from open grasslands to woodlands of Mallee Box *(Eucalyptus porosa)* on the slopes and ridges, to tall gums which line the Cobbler Creek watercourse. The understorey has suffered degradation from overgrazing although scattered remnants are still to be found. The substrate is intact, consisting of rock outcrops with scattered scree from past rock falls.

ACTIVITY PERIODS

Field work was conducted throughout the year and 133 visits were made to the Park between 0930 hours and 1600 hours.

During the spring and summer months observations were made of reptiles basking in the morning. Rabbit warrens are a dominant feature of the recreation park and reptiles were recorded at these sites. Occasionally reptiles were discovered under scattered mallee root stumps or scattered sheets of corrugated iron. In most cases during the warmer part of the day, reptiles were observed by walking through the park.

During winter months when the reptiles were inactive they were usually located under larger rock slabs, mallee root stumps and scattered pieces of corrugated iron.

Table 1. Species recorded at Cobbler Creek Recreation Park

Gekkonidae	Marbled gecko	*Phyllodactylus marmoratus*
	Barking gecko	*Underwoodisaurus milii*
Pygopodidae	Aprasia	*Aprasia pseudopulchella*
	Delma	*Delma molleri*
	Common Scaly Foot	*Pygopus lepidopodus*
Agamidae	Common Bearded Dragon	*Pogona barbata*
Scincidae	Striped skink	*Ctenotus robustus*
	Tree skink	*Egernia striolata*
	Whites skink	*Egernia whitii*
	Three toed skink	*Hemiergis decresiensis*
	Common Grass skink	*Lampropholis guichenoti*
	Bougainville skink	*Lerista bougainvillii*
	Greys skink	*Menetia greyii*
	Adelaide skink	*Morethia adelaidensis*
	Boulengers skink	*Morethia boulengeri*
	Common Blue tongue	*Tiliqua scincoides*
	Shingleback	*Trachydosaurus rugosus*

Elapidae	Red-bellied black snake	*Pseudechis porphyriacus*
	Common Brown snake	*Pseudonaja textilis*
Typhlopidae	Blind snake	*Ramphotyphlops australis*

Table 2. Species Data

SPECIES	NUMBER	RANGE	MEAN
Phyllodactylus marmoratus	16	81mm to 106mm	89.9mm
Underwoodisaurus milii	8	86mm to 110mm	95.7mm
Aprasia pseudopulchella	8	129mm to 146mm	139.50mm
Delma molleri	5	200mm to 261mm	236.4mm
Pygopus lepidopodus	7	216mm to 251mm	228.1mm
Pogona barbata	12	260mm to 401mm	329.7mm
Ctenotus robustus	43	141mm to 220mm	186.2mm
Egernia striolata	5	96mm to 110mm	102.2mm
Egernia whitii	8	169mm to 220mm	192.2mm
Hemiergis decresiensis	51	57mm to 112mm	91.0mm
Lampropholis guichenoti	16	112mm to 141mm	124.4mm
Lerista bougainvillii	40	90mm to 161mm	117.0mm
Menetia greyii	45	38mm to 80mm	61.1mm
Morethia adelaidensis	5	110mm to 122mm	117.2mm
Morethia boulengeri	7	100mm to 128mm	117.6mm
Tiliqua scincoides	24	111mm to 360mm	265.3mm
Trachydosaurus rugosus	58	151mm to 350mm	283.1mm
Pseudechis porphyriacus	1	1200mm	
Pseudonaja textilis	10	900mm to 1300mm	910mm
Ramphotyphlops australis	1	386mm	

CONCLUSIONS

Within the Cobbler Creek Recreation Park 20 species of reptile have so far been identified. The recreation park contains a surprisingly wide range of reptiles for an urban recreation park.

ACKNOWLEDGMENTS

My thanks to the National Parks and Wildlife Service of South Australia, in particular Mr Jim Earl (District Ranger) for his advice and comments. I would also like to thank Dr Mark Hutchinson at the South Australian Museum (Curator of Reptiles) for his advice and assistance.

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A RECORD OF AGGREGATION IN *LERISTA ELEGANS* (LACERTILIA: SCINCIDAE)

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An interesting behaviour recorded in reptiles is aggregation. This has been well documented for snakes (Hoser 1980). Instances of lizard aggregation are listed by Bush (1986), while Swan (1988) includes a record of five *Lerista punctatovittata* found together in a torpid state under sheet iron. This appears to be the only instance of aggregation in *Lerista* documented.

Lerista elegans is widely distributed on coastal plains and offshore islands along the subhumid and arid north-west and mid-west coasts of Western Australia (Wilson and Knowles 1988). In the Perth metropolitan area this skink prefers the sandy soils of coastal dunes and sand plains where it shelters in loose soil beneath leaf litter and low vegetation and man-made debris such as under sheet iron. The following observation was made of numerous *L.elegans* sharing the same shelter site in a Perth residential yard.

On 1 July 1992, nine *Lerista elegans* (see Fig. 1) were unearthed from a shallow soil heap measuring about 30 cm diameter in the Perth suburb of Mount Hawthorn (Lat 31° 57' south Long 115° 51' east). After being told about the find I investigated the site on 12 July 1992 and uncovered a further 43 specimens from the same area. The skinks were inactive after being disturbed and made little attempt to burrow for cover. In total 52 skinks were collected from inside this soil heap. Before releasing the lizards, snout-vent lengths were measured and showed that the aggregation consisted of skinks at various stages of maturity from juveniles with SVL 12 mm to adult with SVL 45 mm, and with an average SVL of 30.8 mm (see Fig. 2).

Greer (1989) mentions specific instances of hibernation aggregation in several south eastern highland skinks and the likelihood of animals being attracted to sites rather than to each other. Heatwole and Taylor (1987) refer to some aggregations that lack social basis but rather represent a mutual response to some favourable condition. The presence of immature animals, the absence of eggs or shell remains and the time of year (being mid July with maximum soil temperature during day of 16 degrees celsius) indicates that this aggregation was not related to communal egg laying but was rather a winter aggregation similar to the instances mentioned by Greer (1989) and Swan (1988) for other skink genera.

An important factor relevant to this record is the unnatural circumstances in which the skinks were living. The yard is enclosed in asbestos fencing, lacks native plants and is mostly covered with lawn, which implies that *L.elegans* can tolerate large scale changes to its habitat. These conditions must be adequate for this species as it is obviously thriving. The winter shelter requirements however may be scarce in this unnatural habitat which could explain the need for skinks to share winter sites. In the natural habitat of this species - large areas of sandy soil with extensive leaf litter coverage, winter shelter sites could be numerous thus obviating the need to aggregate under natural circumstances.

ACKNOWLEDGEMENTS

Thanks to Daniel Browne-Cooper who made the discovery.

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Figure 1. Nine *Lerista elegans* from aggregation showing size range.

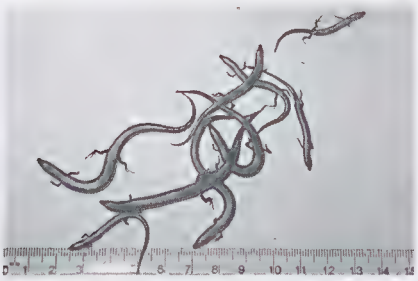
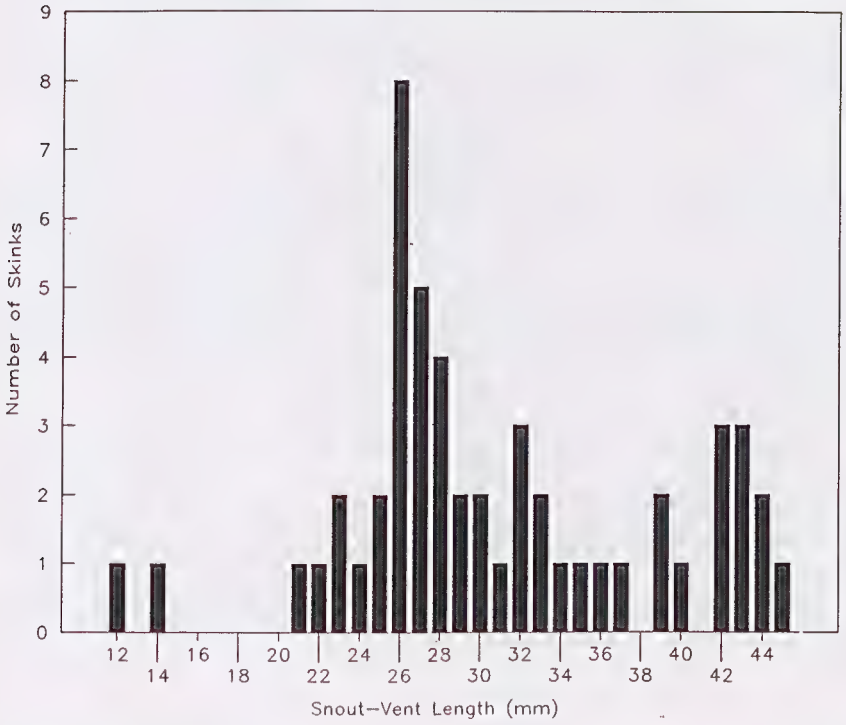


Figure 2. Graph showing snout-vent length distribution in *Lerista elegans* aggregation.



REPRODUCTIVE BIOLOGY OF THE SCALY FOOT, *PYGOPUS LEPIDOPODUS*

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ABSTRACT

The Scaly Foot is oviparous. Most frequently two, occasionally one egg is laid. Incubation of eggs takes ca 106 days. The young hatch in autumn and do not eat until the following spring. As eggs develop, they change from an ovoid to a more spherical shape.

INTRODUCTION

The Pygopodidae is the only reptile family endemic to Australia and New Guinea (Kluge 1974). This family contains some thirty species represented by eight genera (Cogger 1975).

All pygopodid lizards are oviparous (Cogger 1975). Hecht (1976) re-examined the phylogenetic affinities of the Gekkota and hypothesised that the most parsimonious phylogeny is that pygopodids have evolved from the gecko subfamily Eublepharinae. Kluge (1976) presented a phylogenetic cladogram for twenty one species of phygopodids, and in his scheme *Pygopus lepidopodus* is the most primitive extant pygopodid.

Kluge (1976) noted that *P.lepidopodus* has the longest hind limb vestige, that this paddle can be extended, and is the only pygopodid species that exhibits sexual dimorphism in the length of this vestige (Kluge 1974). Many pygopodid males have slightly longer tails and shorter snout/vent lengths than females, and pygopodids lay two elongate leathery eggs per clutch (Kluge 1976). Additional data for two eggs per clutch is given by Wells (1979), Jenkins & Bartell (1980) and Fitzgerald (1983), although Ormsby (1959) found a solitary egg of *P.lepidopodus*, and McPhee (1959) states that four eggs may be laid by this species. This paper presents further information on the clutch size, incubation time and hatching of *P.lepidopodus.*

METHOD

Two gravid *P.lepidopodus* were obtained from near Ewingar State Forest, New South Wales (Lat. 29° 03'S Long 152° 28'E) during a survey of the herpetofauna of the forest (Barker 1981). Both specimens were found under granite on a dry ridge (ca 850m asl).

The specimens were housed separately in glass fronted cages 55 long x 50 wide x 34 high cm. The cages were furnished with leaf mould and rocks. Ovideposition occurred within these cages and the eggs were removed and placed partly into a mixture of four centimetres of unsterilised decayed horse manure and earth in a two litre plastic ice cream container. Before relocation the eggs were marked with a felt pen to maintain orientation and for identification.

No additional water was added to the containers. Incubation temperatures ranged from 20-30° C with a mode of 24° C recorded.

RESULTS

Both clutches were first seen on the 23rd December 1980. Female 1 oviposited a single egg under a rock. Female 2 had oviposited two eggs in an exposed situation and one of the eggs was partially dehydrated. The slight amount of dehydration suggested oviposition had occurred relatively recently.

Eggs were measured and placed in the incubation chamber. Results on incubation time, length and weight of juveniles are given in Table 1.

DISCUSSION

Pygopus lepidopodus is oviparous and can produce a single egg in a clutch. Eggs average 4.0 x 1.7cm (N=3) when laid but change shape during development to become broader. The change in shape may be caused by (1) the developing embryo and/or (2) an uptake of water.

Post Partum incubation time for this species is 106 days (range 99-110, N=3). The young hatch in autumn and may not feed until the following spring, living from stored yolk. Juveniles were observed to break the egg and remain within the egg shell for a period of several hours before emerging. Upon emerging the young sloughed. One specimen (egg C) discarded the umbilical chord and yolk sac within the egg upon hatching.

Fitzgerald (1983) records *P.lepidopodus* hatching after 71 days which is much less than the 99-110 days recorded here. Fitzgerald (1983) incubated his egg at temperatures ranging from 22-32° C whereas the eggs in this study were incubated at about 24° C. The lower incubation temperature of this study may account for the longer incubation time. Under natural conditions along the Gibralter Range Scaly Foot eggs would not have as high an incubation temperature as that given by Fitzgerald (due to the higher altitude) but eggs would experience a greater temperature variation than in the current study.

The reproductive biology of *P.lepidopodus* is unusual because the eggs hatch during a time when the seasonal temperatures are falling. This is in contrast to other oviparous lizards whose eggs hatch during summer or which over winter (Bustard 1970, King & Green 1979).

During a survey of the reptiles and amphibians of the Gibralter Range (Barker, 1981) five specimens of *P.lepidopodus* were collected. Four were gravid females and one a male. Specimens were collected from an altitude of ca 1000m. Although meteorological data for the area is lacking, R. Paine, resident Ranger of Gibralter Range National Park recorded snow falls every year and a minimum temperature of -11° C in July 1979.

It is suggested that *P.lepidopodus* hatch during the onset of winter and hibernate shortly afterwards. Evidence to support this assertion is (1) the duration of incubation (Ormsby, 1959; Wells, 1979; and the present study). (2) reported low temperatures for the area. At these temperatures reptiles would not be active. (3) observed location of pygopodid eggs at Gibralter in situations where the eggs would probably be killed during winter temperature minima.

Pygopodid eggs found at Gibralter (N=2) occurred singly under thin granite rocks. Both eggs had hatched. The finding of single pygopodid eggs relates to the present observation of a single egg clutch in this species although a female may lay in separate localities. One other pygopodid species was collected in the area, namely *Lialis burtonis*.

Of the five *P.lepidopodus* collected at Gibralter, four were russet and one grey coloured, dorsally. Such polymorphism is typical of a species which has a wide distribution. All hatchlings were coloured grey dorsally. It is suggested that ontogenetic differences may occur and that juveniles may change colour with age.

ACKNOWLEDGMENTS

I am sincerely grateful to J. Barker who allowed me to accompany him in field work and provided the above specimens.

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Table 1

FEMALES					
	SV	TL	TT	TS	Wt
1	22.4	51.9*	1.0	1.7	53
2	22.4	65.8*	1.1	1.8	71

JUVENILES					
	SV	TL	TT	TS	Wt
a	9.0	24.9	.6	1.1	5
b	8.5	22.9	.6	1.0	4
c	8.6	22.4	.6	1.0	4

female 1
single egg oviposition 16-22 December 1980

female 2
two eggs oviposition 23 December 1980

EGGS	
a	4.4 x 1.7 on 29 Jan 1981. Hatched 31 March 1981.
b	4.0 x 1.7 on 29 Jan 1981 3.6 x 1.9 on 3 April 1981 Wt 7gm. Hatched 12 April 1981
c	3.5 x 1.7 on 29 Jan 1981 3.5 x 1.7 on 3 April 1981 Wt 6gm. Hatched 10 April 1981

measurements in centimetres,
weights in grams
SV = snout to vent
TL = total length
TT = tympanum to tympanum
TS = tympanum to snout
*tail partly regenerated.

HERPETOLOGICAL NOTES

REPRODUCTIVE RECORD FOR *VERMICELLA ANNULATA SNELLI*

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On 20th November 1991, a gravid female Bandy-bandy of approximately 50 cm snout-vent length, laid 4 eggs from a field mating in the paper substrate of her temporary cage. The slightly dehydrated eggs were removed, measured and placed in damp vermiculite (6 verm: 4 water) and incubated at 30°C. The eggs rehydrated in the vermiculite and became turgid after 2 days. The incubation period was 59 days and the eggs hatched on the 18th January 1992.

Table 1. Dimensions of the eggs at oviposition

EGG #	LENGTH (mm)	WIDTH (mm)
1	37	11
2	41	11
3	43	11
4	40	11

The neonates were the same colour as the adult female (black and white) and 3 of the 4 had pattern anomalies in the form of forked bands and half bands. The adult had a half band near the vent.

Table 2. Birth lengths of neonates (snout-vent only)

NEONATE # (Not related to egg #)	SVL
1	225
2	225
3	214
4	209

These lengths for the neonate snakes are larger than the neonate size of 170 mm estimated by Shine (1980) for *V.a.annulata* from eastern Australia. This is surprising in view of the larger sizes attained by adult *V.a.annulata* both in length and width when compared to the more slender *V.a.snelli.*

The larger neonate sizes recorded here may be an artifact of artificial incubation where the constant high temperature has somehow optimised growth of the developing embryo comparative to the growth of embryos in eggs incubated in natural nests where temperatures are presumably more variable.

The neonate snakes tried to flee an approaching hand rather than raise body loops in the manner of adult animals. However, looping behaviour was seen within a week of hatching and was not specifically tested for at any stage.

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MISCELLANEOUS HERPETOLOGICAL OBSERVATIONS

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The following notes are based on observations of reptile behaviour made over a number of years.

NOCTURNAL BEHAVIOUR IN "DIURNAL" LIZARDS

Nocturnal behaviour in apparently diurnal lizards has been noted previously (Fyfe 1981). The following observations were made in 1987 and involve an agamid and a scincid.

On 8 March 1987 a juvenile *Pogona minor minor* was discovered, apparently basking on a bitumen road at Kambalda East (31° 12'S, 121° 40'E), WA. The time was 8.45 pm.

A little over a month later, on 18 April, an *Egernia formosa* was noted active on a bitumen road at Kambalda West (31° 13'S, 121° 38'E) at 6.50 pm.

DEFENSIVE BEHAVIOUR

Ramphotyphlops australis. A specimen was collected on 21 September 1986 at Kambalda West. It was discovered beneath a piece of chipboard lying on damp soil on the outskirts of a little-used rubbish tip.

When handled it would open its mouth wide, extend its tongue rigidly and exude a rather thick, clear mucus which it would then wipe around its snout with its tongue. It did this continuously whilst I handled it. Each time I removed the mucus it would replace it immediately. The mucus had a rather strong, pungent smell, although not as pungent as the fluid often exuded from the vent of this species. I noticed that this specimen did not exude any fluid from the vent.

FIELD COMPATIBILITY

On 23 August 1992 at Widgiemooltha (31° 29'S, 121° 35'E), WA, I discovered a *Delma fraseri* occupying the same refuge as two *Rhinoplocephalus gouldii.* They were beneath a large (approx. 1.5m x 0.9m) piece of sheet-metal, which when lifted revealed all three specimens in contact. The *D. fraseri,* upon being disturbed, immediately took refuge in nearby dense vegetation. The *R. gouldii* made little movement and were more closely examined; they were cool to the touch and quite sluggish in their movements.

That *D. fraseri* should be compatible with lizard eating *R. gouldii* (pers. obs.), seems unusual, although compatibility in the field has been noted in snakes and lizards previously (Maryan and Robinson 1987). Perhaps the cool ambient temperature and the relative sizes of the specimens had some bearing. The *R. gouldii* had total lengths of approx. 300mm compared to approx. 400mm for the *D. fraseri.*

Within three metres of these specimens was another piece of sheet-metal, measuring approx. 0.6m x 0.3m. Beneath this were a *Heteronotia binoei,* an *Underwoodisaurus milii* and a juvenile *R. gouldii.* However none of these was in contact and may have been unaware of each other.

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OBSERVATION OF SCENT FOLLOWING IN A MALE CARPET PYTHON *(MORELIA SPILOTA VARIEGATA)*

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On Thursday 26th July 1990, at 20:30 hours, I located a large male (determined by probing) Carpet Python *(Morelia spilota variegata)*, 10 km east of the Cooinda alternative route turn-off on the Arnhem Highway (Lat 12° 49'S, Long 131° 59'E). This animal was moving steadily north and crossed the road in front of my stationary car, seemingly unaffected by my presence. The approximate temperature was 16° C. After a few minutes observation I picked the animal up and took measurements, then moved the animal some distance into the bush away from the road, in the direction it had been moving. The snake had a snout-vent length (SVL) 2080 mm, head length 54.5 mm, head width 34.1 mm and weight 2.5 kg.

On Saturday 28th July 1990 at approximately 20:00 hours, whilst heading back towards Darwin, I arrived at the point of capture of the first Carpet Python. I was travelling at 60 kmh and saw another Carpet Python make its way on to the roadway at the same point the first had emerged. It was travelling the same path the first python had two days previously. My car tyre marks from the 26th were still visible. This second animal, also a male (probed), was much smaller (SVL 1540 mm, head length 47.6 mm, head width 32.7 mm, weight 1.3 kg).

The progress of this second animal was somewhat slower than that of the first, and it took at least five minutes to cross the road. On reaching the verge of the road its speed increased, but came to an abrupt halt at the point where I had removed the first python. For almost ten minutes its behaviour was unusual, the tail began to twitch as in many pythons when stimulated by food (pers. obs.). The head began to move from side to side and, as I approached with a torch I noted that the tongue was almost continuously out. While it had been crossing the road the head was held close to the ground. However, when it reached the point where I had found the first python, its head lifted off the ground. At no stage did the second animal move past the point where the first had been removed, and it appeared to be totally oblivious to my presence, even when I was less than 30 cm away.

The behaviour exhibited by this second python, particularly being in the same location as the first had been, leads me to conclude that I had witnessed sex pheromone trail following by a male Carpet Python. It is unknown whether both animals were following the trail of a female which may have moved along the same path some time previously. It is interesting to note that this apparent scent trail had lasted a minimum of 45.5 hours, with the slow progress of the second animal due possibly to the number of cars which had crossed the trail, thereby rendering it less discernible. Male Water Pythons *(Liasis fuscus)* follow females during the breeding season of July and August. At times there is a constant procession of male Water Pythons in single file on a pheromone trail, following one female at Fogg Dam (Thomas Madsen, pers. comm., pers. obs.). The literature on sex pheromone trail following in reptiles is scarce for Australia. It has been shown that female sleepy lizards *(Tiliqua rugosa)* are able to locate their male partners by smell, implying that males may emit a sex pheromone (Bull *et al*, in press).

ACKNOWLEDGMENTS

Many thanks to Keith Christian and Thomas Madsen for their help and support and John Read, Greg Fyfe and Paul Horner for their advice and criticism.

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NESTING OBSERVATIONS ON THE LACE MONITOR *VARANUS VARIUS*

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On 22 September 1984 at Glenrock Lagoon just south of Newcastle, NSW I located a *Varanus varius* nest in an arboreal termite mound. The surrounding vegetation was dry sclerophyll forest mainly composed of ironbark dominant coastal stunted Eucalypts.

The termite mound was situated approx. 3 metres above ground in a half dead small eucalypt and was soft and flaky. There was one large hole near the top of the mound and several smaller ones lower down.

A hatchling (total length 30 cm) *Varanus varius* was sunbasking on the side of the mound. The reptile was one or two days old and was apparently the first of the clutch to hatch. A check was kept on the nest over the following fortnight.

23 September
The same juvenile was again sunbasking on the mound. (Also present was a 50cm Scaly Foot *(Pygopus lepidopodus)* sunbasking on the track nearby).

25 September
3 juveniles sunbasking on mound, extremely wary at this stage. (Also present was a Ringtail Possum *(Pseudochierus peregrinus)* sleeping in the large hole at the top of the mound).

2 October
6 hatchlings present; 4 sunbasking on top of mound (see Figure 1) and another 2 foraging on the ground within 10 metres of the nest. One of these had just captured a large Praying Mantis on the ground. When disturbed on the ground they would run up trees and lie upside down on slender vertical branches where they would blend completely with the dappled sunlight and shadows.

6 October
Nest deserted. One juvenile located 30 metres from the nest battling with a large Huntsman spider.

DISCUSSION

The above observation indicates that the eggs incubate during winter to hatch with the first warm days of spring. As mating in this species occurs in mid summer (Tasoulis 1983) and eggs would be laid before winter begins, there is an incubation period of 6 months and possibly longer. Field observations on egglaying are required to pinpoint precise times. It was of interest to note the rapid dispersal of the young after hatching with only a fortnight elapsing from the first hatching to nest desertion. Field observations are also required to clarify the question of parental assistance.

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Figure 1. *Varanus varius* hatchlings basking at nest site.



RECORD OF AN AGGREGATION OF *DELMA INORNATA*

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On the 4th October 1992, eight specimens of *Delma inornata* were located under a piece of corrugated iron approximately 50km south west of Yass NSW (34° 56'S, 148° 32'E). The time was 11.45am and the temperature was 17°C.

The piece of iron measured about 1.2 metres x 1.2 metres and was located in a cleared paddock in the middle of a sheep grazing area. The surrounding grass was 50-70 mm high. The iron was one of several pieces lying around and three other specimens of *Delma inornata,* one pair and one single specimen, were located under similar debris within 20m of the main aggregation. The lizards dispersed into the surrounding grass as soon as they were disturbed and it is presumed that they were aggregating for breeding purposes. To my knowledge there has been no other record of an aggregation of this species.

PREY ITEMS OF THE RED-BELLIED BLACK SNAKE *(PSEUDECHIS PORPHYRIACUS)*

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Shine (1977) gives a most detailed account of the diet of the black snake which he found to be mainly frogs (82% of food items) and lizards (13% of food items). Other food items reported for this species include mammals, birds, fish and insects (Rose, 1974 and Webb & Rose, 1984 in Webb, 1987). Webb (1987) records *Tiliqua nigrolutea* and *Eulamprus tympanum* from the stomachs of road killed black snakes from Bombala. Gow (1976) states that the food of black snakes consists of frogs, fish, eels, mice, rats, birds and snakes and that the species is prone to cannibalism. However, later editions of this book do not list eels and do not mention cannibalism.

During 1978 I captured a black snake at Stanwell Park, NSW which regurgitated a smaller black snake. The larger snake measured 1020mm snout-vent length, 175mm tail length and weighed 600 gms. The smaller snake measured 610mm snout-vent length, 115mm tail length and weighed 110 gms.

In the same year at Nowra, NSW I observed a black snake eating an eel *(Anguilla australis)*. The disturbed snake began to regurgitate the eel but fortunately the operculum/pectoral fins of the eel stuck in the snake's mouth and the snake began to reconsume the eel. This gave me adequate time to photograph the incident (Figure 1).

At Nowra, NSW on December 2, 1991 a large (ca 1700mm) black snake was observed on the edge of a pond where many frogs *(Limnodynastes peroni)* were calling. The snake was captured and regurgitated five or six *L.peroni* and several *Litoria dentata*. One *L.dentata* dropped into the water, opened its eyes and swam away. The frog must have been consumed a few minutes before I caught the snake, otherwise it would have died of asphyxiation. It did not appear to be damaged and the size of the snake's head in relation to that of the small frog accounts for the lack of teeth punctures.

Snakes often display cannibalistic behaviour when in captivity. Such behaviour may often be elicited by animals fighting over a food item. When two snakes try to eat the same item the larger snake may continue to eat the smaller snake which is attached to the food. Observations of cannibalism in free range animals are rare.

Worrell (1963) shows a black snake eating an eel. Although this photograph was possibly taken in the Australian Reptile Park and hence is of a captive animal, free range black snakes do eat eels. The reason why Shine (1977) never obtained eels in the diet of the 119 specimens sampled relates to the area in which the sample was taken. Eels are rare or absent from the New England region because of the area's high altitude and cold winters (200 frosts a year - Hobbs and Jackson, 1977 in Taylor, 1984).

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Figure 1. Black snake *(Pseudechis porphyriacus)* eating an eel.



BOOK REVIEW
"ENCYCLOPAEDIA OF AUSTRALIAN ANIMALS FROGS"

Text by Michael J. Tyler. Series Editor Ronald Strahan.
The National Photographic Index of Australian Wildlife
The Australian Museum. Angus and Robertson Books

This book has several features that make it a must for any person interested in Australian frogs or wildlife in general. The most outstanding feature is the superb quality of the photographs. Credit for these goes to the photographers, who are named adjacent to each picture, and to the National Photographic Index, which has assembled this invaluable collection. The Index, which is held by the Australian Museum, has previously served as the core of two very popular and authoritative books on the natural history of Australian animals, *The Reader's Digest Complete Book of Australian Birds,* and the *Australian Museum's Complete Book of Australian Mammals.* This book will further enhance the reputation of the Index. An attempt has been made to include a photograph of every species of Australian frog. This is a formidable task in itself, and only a small number of species are not illustrated. The text, written by Michael Tyler, is clear and lucid, and provides fascinating insights into the biology of the animals without getting bogged down in lengthy detail.

When buying a book most people ask two straight-forward questions, is it value for money? and will it be one of the books in the home library that is often thumbed through? Without doubt, this book is good value. What you get are photographs that represent many hours of painstaking field work by dedicated amateur and professional nature photographers. In several cases the photographs are of extremely rare and cryptic animals. Sadly, in the case of some of the animals presented, such as the Gastric-Brooding Frog and Southern Day Frog, they may never be photographed again, because of the reasonable fear that these species may already be extinct. In this respect the Index and this publication are invaluable national assets. The book will be

one that is used regularly by many people when trying to identify a frog found in the garden or observed in the bush, and by those with an interest in natural history because of the great diversity that it reveals.

This is not a technical book, rather it provides an overview of the Australian frog fauna. Some technical terms are used, and a helpful glossary is included. For each species the text is limited to a brief description of the animal or some particular aspect of its biology with details of adult size, habitat, distribution, abundance and survival status. For those who wish to know more about the biology of Australian frogs this book will be a disappointment. Because of its size and format this book is not suitable as a field guide, and it does not pretend to play this role. However, it will be of great value to those who wish to identify species in their local area or those observed while travelling. In this respect the inclusion of adult size and habitat are useful aids.

The author, Michael Tyler, gives a prognosis of the survival status of each species, based on a six tiered listing with operational definitions of each tier. This should be recognised as a very difficult task, and in the Introduction (common to all four volumes in the series), it is noted that because this is the first attempt to survey the survival status of Australian frogs, some of the evaluations will inevitably include some errors of fact or judgment. At the very least this section beckons the reader to critically examine the survival status of various species. This should be of great concern for all naturalists not just for those interested in frogs, because the current rapid decline in frog populations represents a serious change in the natural environment. I do not criticise the attempt to determine status, but find it very difficult to accept some of the prognoses. Undoubtedly the long lead time required in the production of a book means that recent evidence cannot be readily accommodated. However, it is unfortunate that the definitions have not been applied consistently. The Gastric-Brooding Frog *Rheobatrachus silus* is listed as *possibly extinct*, while the Diurnal Frog *Taudactylus diurnus* is listed as *possibly endangered*, yet these two species have not been seen in the field for over a decade and they occurred together in part of their natural range. This is even more disturbing when the definition of *possibly endangered* includes the phrase, "...the population is still large and viable". Unfortunately, the survival status reported for many of the species does not bear with the currently known situation. This book offers a wonderful opportunity to draw this dramatic situation to the Australian public, but as currently presented these alarming facts are missing. I can only presume that the text was written well before the current situation became clearly apparent. Species listed as secure ("No existing or foreseeable threat to continuance of the species"), such as *Pseudophryne corroboree, Mixophyes fleayi, Litoria aurea, L.nyakalensis* and *L.piperata*, should now be considered *possibly endangered* or *endangered*. Similar pessimistic prognoses could be made about the three species of *Taudactylus* and these species should be rated as *possibly endangered* or *endangered*.

There are a small number of mistakes in the photographs and text, which should be corrected to prevent confusion. On page 48 the photographs of *Crinia tinnula* and *Geocrinia laevis* have apparently been swapped, the photo of *Limnodynastes depressus* on page 56 is of a specimen of *Megistolotis lignarius*, and the stated distribution for *Pseudophryne coriacea* is correct for north-eastern New South Wales, but this species is not found in south-eastern Victoria.

Michael Mahony.

BOOK REVIEW
ENCYCLOPEDIA OF AUSTRALIAN ANIMALS. REPTILES.

Ehmann, Harald.1992. Encyclopedia of Australian Animals. Reptiles.
The National Photographic Index of Australian Wildlife, The Australian Museum.
Angus and Robertson, Pymble, NSW. 495pp. Rec. retail price $49.95.

This is one of only three books to have ever attempted to cover in a thorough manner all the species of reptiles in Australia. The first of these books is Worrell's "Reptiles of Australia" (1956; Angus and Robertson), now long out of date and print, but in its time a locally important work that in terms of its broad concept, if not execution, remains unique in Australian herpetology. The second book is H.G. Cogger's "Reptiles and Amphibians of Australia" (latest, revamped edition, 1992, Reed Books), the premier identification guide for Australian herpetofauna. The third book is Ehmann's "Encyclopedia of Australian Animals. Reptiles", the first work in the literature of Australian herpetology to call itself "encyclopedic".

The heart of Ehmann's book is an account of every species of Australian reptile giving, in a parallel and standard fashion, basic information on colour pattern, behaviour, feeding habits, reproduction, habitat, distribution, and conservation status. Each account is accompanied by a colour photo of the animal (a drawing or no image must suffice for a few hard to come by species), most taken by the author, and a map of its distribution. The author's personal observations, based on extensive experience, are often included, and these are usefully noted as being his own contribution. The species accounts are organised taxonomically and are preceded by concise accounts of immediately higher relevant taxonomic group: genus, family and order.

There are several novel features in this book. First, it is the first post-Worrell attempt to provide a concise resume of the known basic natural history of each species of Australian reptile. This is a big job requiring both a fairly broad knowledge of the literature and an ability to select the main points and present them concisely. This the book does reasonably well, although there are the inevitable little errors that arise out of dealing with so much information. For example, gestation period in file snakes *(Acrochordus)* is said to be 11 months, whereas direct and indirect observations both suggest that it is more like six months.

Second, the book gives a common name to every species. Common names are very useful to non-specialists, but such names pose a problem in not being standardised. As there is no international convention governing the proposal and maintenance of common names as there is for scientific names, standardisation can only be achieved by widespread user acceptance. By providing thoughtful common names for all Australian reptiles, the author has done about as much as one person can do to develop a nomenclature of standard common names for Australian reptiles. Some of my favourite names on the grounds of euphony and imagination are the Lashtails *(Amphibolurus)*, Bicycle Dragons (for some *Ctenophorus*), the Cool-skinks *(Leiolopisma)*, the Shinning-skinks *(Cryptoblepharus)*, the Sliders *(Lerista)*, the Mulch-skinks (for some *Sphenomorphus*). Although this is a good beginning, there are still some problems. For example, who would guess that the Slender Slider is a pygopodid *(Pletholax gracilis)* and not a skink. And is "Mangrove Snake", used as a root name for two species of homalopsine colubrids and three species of hydrophiids, not likely to lead to the conclusion that these species, at least in their own groups, are closely related - a conclusion that would not be unexpected given the use of similar root names for other apparently closely related species in other groups (see above).

The third novel feature of Ehmann's book is the attempt to evaluate the conservation status of every Australian reptile. While this work may be superseded by a much larger and more broadly

based effort in the near future, it is the only "standard reference" that increasingly desperate conservation bodies can turn to for a uniform and relatively objective overview of the conservation status of Australian reptiles.

I have three quibbles with the book. First, there is a tendency to assume details about the biology of some of the animals that are as yet unproved. For example, the elapid snakes *Furina ornata, Glyphodon barnardi, G.tristis, Simoselaps anomala, S.approximans, S.bimaculatus, S.fasciolatus* and *S.roperi* are said or implied to be egg-layers and *Denisonia fasciata* and *D.maculata* live bearers, whereas the actual mode of reproduction of all these species is unknown. An inference can be made on the basis of what is known of these snakes' near relatives, but is an "encyclopedia" the place to be making these inferences, especially without flagging them as such?

Second, many of the author's own observations should be more fully elaborated upon in separate publications. Take for example, the author's observation on the relatively primitive sea snake *Parahydrophis mertoni* that "developmental changes in the Northern Mangrove Seasnake suggest that animals may have predominantly intertidal behaviour when young; below the level of low tide when adult." This is a fascinating observation, but it is too important to stand alone like this. Will further details be forthcoming in the scientific literature? If not, what are we to make of these and other equally intriguing but concisely presented original observations?

Third, in that the photo captions do not give details of the locality of the specimen depicted, much potentially useful information is foregone. For example, the text for the Carpet Python *(Morelia spilota)* gives concise descriptions of the geographical colour variants of this species, and there are accompanying photos of two of the variants. However, it is not stated which form they represent nor from where they come. This may not be a problem to a knowledgeable local reader but what about an uninformed but keen overseas reader? And if an interesting nuance of colour pattern catches the eye of a taxonomist, his ability to follow up the lead is made more difficult without knowing the origin of the specimen. However, to be fair, the lack of locality in the photo captions may have been a constraint imposed by the editorial requirements of the series of which this book is a part.

This book is truly encyclopedic in the sense of presenting information authoritatively and concisely, that is, without references and without much opportunity for qualification and discussion. It will therefore be most useful to those whose need for information is at this level. For those whose needs are more discriminating and detailed, the book will be nonetheless useful for the author's original observations, another set of very beautiful pictures, a handy set of distribution maps, and the only uniform overview of current conservation status of every Australian reptile species.

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NOTES TO CONTRIBUTORS

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